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Report on the Hepaticae of Alaska*

ALEXANDER W. EVANS

(WITH PLATE 21 AND THREE TEXT FIGURES)

INTRODUCTION

Through the kindness of Professor T. C. Frye, of the University of Washington, the writer has recently received a large collection of Alaska Hepaticae for determination. It was made in 1913 under the auspices of the Kelp Investigation Expedition of the United States Bureau of Soils. The vast majority of the specimens were collected by Professor Frye himself, but his collection is supplemented by a few specimens collected by Mr. A. B. Foster, Dr. G. B. Rigg, and Dr. R. B. Wylie. The specimens were all gathered near the coast, the easternmost locality being Verdure Creek, near the upper end of Portland Canal, and the westernmost, Mitrofania Bay on the Alaska Peninsula. In spite of the fact that the region visited represents a relatively small portion of Alaska, the collection is the most comprehensive which has yet been brought back from the territory. It includes seventy species in condition to be identified, twenty being new to Alaska (or not before reported), seven new to America, and three new to science. The next largest collection, that of the Harriman Alaska Expedition, contained sixty-three species, thirty-nine of which were reported from Alaska for the first time. Of these thirty-nine species six were new to America and one, *Scapania cordifolia* K. Müll., was new to science, although it was at first confused with another species.

* Contribution from the Osborn Botanical Laboratory.

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The present report is based on Professor Frye's collection, but it reviews also what is known from other sources about the Hepaticae of Alaska and compares the species found in the territory with those occurring in other parts of the world. In addition to the seventy species represented in the present material, forty other species have been reported from Alaska. Five of these reports, however, were based on incorrect determinations or insufficient evidence, so that only thirty-five of the species can actually be accredited. The total number of species now known from Alaska is, therefore, 105. This number will probably be more than doubled when the flora has been more thoroughly explored.

BIBLIOGRAPHY

In the writer's report on the Hepaticae of the Harriman Expedition the literature of the Alaskan species is reviewed up to the close of 1900. Since that time a small collection of species has been reported upon by the writer, and another small collection by Howe, while a few additional species have been recorded by K. Müller and Stephani. The more important papers dealing with Alaskan species or containing scattered references to them are the following, only those which give actual new records being included:

1. **Cooley, Grace E.** Plants collected in Alaska and Nanaimo, B. C., July and August, 1891. Bull. Torrey Club **19**: 239–249. 1892.

A list of thirteen Hepaticae from Alaska is given on pages 246 and 247, six of the species being reported for the first time.

2. **Coville, F. V.** Botany of Yakutat Bay, Alaska. II.—Botanical report. Contr. U. S. Nat. Herb. **3**: 334–353. 1896.

A list of eight Hepaticae is given on page 351, two being reported for the first time.

3. **Evans, A. W.** Papers from the Harriman Alaska Expedition. V. Notes on the Hepaticae collected in Alaska. Proc. Wash. Acad. Sci. **2**: 287–314. *pl. 16–18.* 1900.

Sixty-three species are listed, including thirty-nine additions to the Alaska flora; two other additions are mentioned incidentally.

4. **Evans, A. W.** Hepaticae collected by William A. Setchell in northern Alaska. Zoe **5**: 129–132. 1901.

Twenty-three species are listed, two for the first time.

5. **Gottsche, C. M., Lindenberg, J. B. G.,** and **Nees von Esenbeck, C. G.** Synopsis Hepaticarum. Hamburg. 1844–47.

Four species are reported from Alaska, all for the first time.

6. **Howe, M. A.** The North American species of *Porella*. Bull. Torrey Club **24**: 512–527. 1897.

Two species are noted from Alaska, one for the first time.

7. **Howe, M. A.** The Hepaticae and Anthocerotes of California. Mem. Torrey Club **7**: 1–208. *pl. 88–122*. 1899.

Several species are reported from Alaska, three for the first time.

8. **Howe, M. A.** Contributions to the botany of the Yukon territory. I. An enumeration of the Hepaticae collected by R. S. Williams, 1898–1899. Bull. N. Y. Bot. Gard. **2**: 101–105. *pl. 14*. 1901.

Several of the species listed, including two additions, came from Alaska. One of the species, *Scapania imbricata*, is described as new and figured.

9. **Merriam, C. H.** Plants of the Pribilof Islands, Bering Sea. Proc. Biol. Soc. Wash. **7**: 133–150. 1892.

A list of three Hepaticae is given on page 150, the records being new but containing no additions to the Alaska flora.

10. **Müller, K.** Neue und kritische Lebermoose. Bull. Herb. Boissier II. **3**: 34–44. *pl. 1*. 1903.

A new species, *S. cordifolia*, is described from Alaska specimens.

11. **Müller, K.** Monographie der Lebermoosgattung *Scapania* Dum. Nova Acta Kaiserl. Leop.-Carol. Acad. **88**: 1–312. *pl. 1–52*. 1905.

Several species are quoted from Alaska, a few of the records being new, although no additions to the Alaska flora are reported.

12. **Pearson, W. H.** List of Canadian Hepaticae. 1–31. *pl. 1–12*. Montreal. 1890.

Several species are quoted from Alaska, one record being new.

13. **Rothrock, J. T.** Sketch of the flora of Alaska. Rept. Smithsonian Institution for 1867: 433–463. 1867.

A list of six Hepaticae, all representing additions to the flora of Alaska, is given on page 462.

14. **Stephani, F.** Hepaticae von der Halbinsel Alaska, gesammelt 1881/1882 von den Doctoren Arthur und Aurel Krause. Bot. Jahrb. **8**: 96–99. *pl. 3, f. 9–11*. 1887.

Twenty-two species are listed, sixteen for the first time. Of these sixteen species four are described as new, viz., *Scapania albescens*, *Radula arctica*, *R. Krausei*, and *Frullania chilcootiensis*. The *Scapania*, however, is synonymous with *S. Bolanderi*, while *R. arctica* is probably synonymous with *R. Bolanderi* and *R. Krausei* with *R. complanata*.

15. **Stephani, F.** Species Hepaticarum. Bull., Mém., and Compl. au Bull. Herb. Boissier. 5 vols., the fifth in course of publication. 1898–1914.

Several species are recorded from Alaska, three for the first time.

16. **Underwood, L. M.** A preliminary list of Pacific Coast Hepaticae. Zoe 1: 361–367.
Among the species quoted from Alaska two represent additions to the flora.

LOCALITIES VISITED BY THE KELP EXPEDITION

The portion of Alaska investigated by the Kelp Expedition falls almost entirely within the Pacific Coast Forest region, as defined by the United States Forest Bureau. One or two of the westernmost stations, where arctic conditions prevail, offer the only exceptions to this statement. All of the localities visited are on or near the coast and are characterized by a heavy rainfall and low temperatures, although extremes of cold are rarely encountered. These conditions are unusually favorable for the growth of Hepaticae, and it is not surprising that they form a significant element of the flora.

With five exceptions the localities where the Hepaticae were collected are situated in the southeastern part of Alaska, a district containing numerous islands separated from one another and from the mainland by narrow channels. Forests abound everywhere, the prevailing tree being the western hemlock, *Tsuga heterophylla* (Raf.) Sarg. Another conspicuous tree is the Sitka spruce, *Picea sitchensis* (Bong.) Carr., while the Alaska cypress, *Chamaecyparis nootkatensis* (Lamb.) Spach, and the mountain hemlock, *Tsuga Mertensiana* (Bong.) Carr., are of frequent occurrence. Among deciduous trees the red alder, *Alnus rubra* Bong., is perhaps the most abundant. The five stations which are not in the southeastern part of Alaska represent a portion of the territory where the western hemlock, the Sitka spruce, and the mountain hemlock reach the northern and western limits of their ranges and gradually disappear. The balm-of-Gilead, *Populus balsamifera* L., is a deciduous species occurring in the same region.

The accompanying map (TEXT FIG. 1), after a sketch by Professor Frye, will show how most of the localities where specimens were collected are situated, and the following data, likewise supplied by Professor Frye, will give further information about the localities. The numbers correspond with those on the map.

1. AATS BAY. North shore of Coronation Island. The collections were made about the south end of the west arm and on the

peak to the southward. About latitude 55° 53′ and longitude 134° 15′.

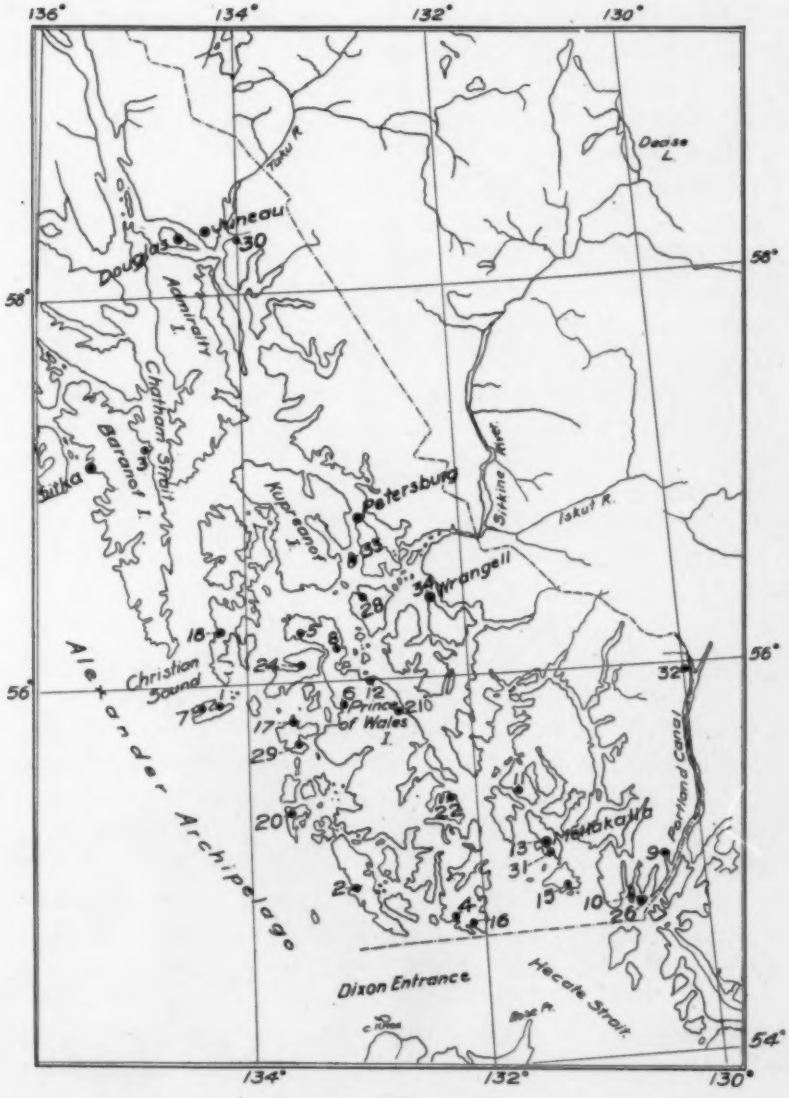


FIG. 1. Map of southeastern Alaska, showing most of the localities visited by the Kelp Expedition. Drawn by Mr. S. J. Berard, after a sketch by Professor T. C. Frye.

2. AUGUSTINE BAY. West shore of Dall Island, just north of Cape Augustine. The collections were made within a half mile of the head of the Bay. About latitude 54° 58′ and longitude 133° 11′.

3. BARANOF. Post office and warm springs on Warm Spring Bay, east shore of Baranof Island. The collections were all made within 300 yards of the warm springs. About latitude 57° 5′ and longitude 134° 50′.

4. BROWNSON BAY. South shore of Prince of Wales Island. The collections were made on a trip from the head of the Bay westward to the head of a large lake about a mile and a half distant, then down the east side of the lake to its outlet and diagonally back to the head of the Bay. About latitude 54° 46′ and longitude 132° 15′.

5. CALDER. Post office and quarry on Shakau Bay, Prince of Wales Island. The collections were made within quarter of a mile of the quarry. About latitude 56° 10′ and longitude 133° 27′.

6. DEWEYVILLE. Indian village on Prince of Wales Island at Sarkar Cove, an indentation opening on El Capitan Passage. The collections were made at the head of the Cove within quarter of a mile of the village. About latitude 55° 57′ and longitude 133° 14′.

7. EGG HARBOR. North shore of Coronation Island. The collections were made near the south end of the Harbor and along a stream to the westward for about a mile. About latitude 55° 54′ and longitude 134° 19′.

8. EXCHANGE COVE. Shore of Prince of Wales Island, southeast of Zarembo Island. The collections were made on the north shore of a stream flowing into the Cove. About latitude 56° 12′ and longitude 133° 5′.

9. HIDDEN INLET. An arm of Pearse Inlet near the mouth of Portland Canal. The collections were made at the mouth of the Inlet, on the west shore. About latitude 54° 56′ and longitude 130° 20′.

10. KANAGUNUT ISLAND. Very near the southeast corner of Alaska. The collections were made along the east shore and about a quarter of a mile from the north end. About latitude 54° 5′ and longitude 130° 43′.

11. KETCHIKAN. Town on Tongass Narrows. The collec-

tions were made chiefly along a creek. About latitude 55° 21′ and longitude 131° 38′.

12. LAKE BAY. Northeast shore of Prince of Wales Island, south of Zarembo Island. The collections were made near the shore and about quarter of a mile north of the cannery. About latitude 56° 1′ and longitude 132° 55′.

13. METLAKATLA. Town on the west shore of Annette Island. The collections were made near the shore eastward and along a stream with a waterfall, the outlet of a lake about two miles from the town. About latitude 55° 7′ and longitude 131° 33′.

14. MITROFANIA BAY. Southeast shore of Alaska Penninsula, northeast of the Shumagin Islands. About latitude 56° 0′ and longitude 158° 45′. Not shown on the map.

15. MORSE COVE. South shore of Duke Island. The collections were made along the shore of the Cove and about two miles to the southwestward. About latitude 54° 55′ and longitude 131° 16′.

16. NICHOLS BAY. South shore of Prince of Wales Island, near Cape Chacan. The collections were made on and near the west side of the Bay, About latitude 54° 43′ and longitude 132° 8′.

17. PORT ALICE. North shore of Heceta Island. The collections were made along the west shore of an inlet and near the head. About latitude 55° 48′ and longitude 133° 35′.

18. PORT MALMSBURY. West shore of Kuiu Island. The collections were made along the west shore and near the head of the second arm to the southward. About latitude 56° 12′ and longitude 134° 9′.

19. PORT CHATHAM. Near the western end of Kenai Peninsula at the mouth of Cook Inlet. The collections were made along the north shore. About latitude 59° 14′ and longitude 151° 45′. Not shown on the map.

20. PORT SAN ANTONIO. East shore of Baker Island. About latitude 55° 22′ and longitude 133° 37′.

21. RATZ HARBOR. East shore of Prince of Wales Island, opposite Etolin Island. The collections were made near the south arm of the Harbor, close to the mouth of the salt water lagoon. About latitude 55° 53′ and longitude 132° 35′.

22. SALTERY COVE. An indentation of Kasaan Bay, on the

east shore of Prince of Wales Island. The collections were made at the head of the Cove, within quarter of a mile of the cannery. About latitude 55° 24′ and longitude 132° 19′.

23. SEWARD. South shore of Kenai Peninsula. About latitude 60° 8′ and longitude 147° 45′. Not shown on the map.

24. SHIPLEY BAY. Northwest shore of Prince of Wales Island. The collections were made at the head of the Bay near the mouth of a creek. About latitude 58° 5′ and longitude 133° 8′.

25. SHUYAK ISLAND. North of Afognack Island. The collections were made along the shore of an unnamed bay, at the southwest corner of the Island. About latitude 58° 30′ and longitude 152° 27′. Not shown on the map.

26. SITKLAN ISLAND. Southeast corner of Alaska. The collections were made along the southwest shore. About latitude 54° 44.5′ and longitude 130° 41′.

27. SNUG HARBOR. Southeast shore of Knight Island in Prince William Sound. About latitude 60° 16′ and longitude 147° 45′. Not shown on the map.

28. ST. JOHN HARBOR. Northwest shore of Zarembo Island. The collections were made within two miles of the shore. About latitude 56° 26′ and longitude 132° 56′.

29. SWIFTS CANNERY. Southeast shore of Heceta Island. The collections were made within quarter of a mile of the cannery. About latitude 55° 43′ and longitude 133° 29′.

30. TAKU INLET. South of Juneau, receiving the Taku and Turner rivers. The collections were made along the east shore of the Inlet at the mouth of Turner River and about four miles south of Taku Glacier. About latitude 58° 25′ and longitude 134° 0′.

31. TAM GAS HARBOR. South shore of Annette Island. The collections were made near the shore from Crab Point northwestward for a distance of about a mile and a half. About latitude 55° 4′ and longitude 131° 33′.

32. VERDURE CREEK. A small stream emptying into Portland Canal near the upper end and about one mile north of Verdure Point. The collections were made near the mouth of the Creek. About latitude 55° 45′ and longitude 130° 10′.

33. WOEWODSKI ISLAND. South entrance to Wrangell Strait.

The collections were made within a quarter of a mile of the abandoned Olympic Mine. About latitude 56° 31′ and longitude 133° 2′.

34. WRANGELL. Near the mouth of the Stikene River. The collections were made within a few miles of the town. About latitude 56° 28′ and longitude 132° 22′.

HEPATICAE COLLECTED BY THE KELP EXPEDITION

In the following enumeration the numbers in parentheses refer to the papers listed in the Bibliography, see page 578. Only those records are quoted which were new at the time they were published. Unless otherwise noted the specimens listed were collected by Professor Frye. The arrangement adopted is that of Schiffner in Engler & Prantl's Die natürlichen Pflanzenfamilien.

MARCHANTIACEAE

1. CONOCEPHALUM CONICUM (L.) Dumort.

On wet soil. Aats Bay (*904*); Augustine Bay (*584*); Hidden Inlet (*59*); Ketchikan (*18*); St. John Harbor (*240*); Swifts Cannery (*693*). Previously reported by Rothrock (**13**, as *Fegatella conica*), Stephani (**14**, p. 99, as *F. conica*), Miss Cooley (**1**, p. 246), and the writer (**3**, p. 290; **4**, p. 129).

2. PREISSIA QUADRATA (Scop.) Nees

On soil among stones. Aats Bay (*937*). Previously reported by Stephani (**14**, p. 99), Miss Cooley (**1**, p. 247, as *P. hemisphaerica*), and the writer (**3**, p. 290; **4**, p. 129).

3. MARCHANTIA POLYMORPHA L.

On damp soil. Calder (*829*); Woewodski Island (*964*). Previously reported by Rothrock (**13**), Stephani (**14**, p. 99), Miss Cooley (**1**, p. 247), and the writer (**3**, p. 291; **4**, p. 129).

METZGERIACEAE

4. RICCARDIA LATIFRONS Lindb.

On bogs, sticks, and wet soil. Calder (*827* in part); Exchange Cove (*261*); Ketchikan (*505*); Nichols Bay (*391*); Port San Antonio

(*609*, *618*); Swifts Cannery (*700*). Previously reported by the writer (**3**, p. 291).

5. RICCARDIA MULTIFIDA (L.) S. F. Gray

On wet rocks and logs. Port Alice (*728* in part); Port Malmsbury (*994*). New to Alaska.

6. METZGERIA CONJUGATA Lindb.

On rocks, trees, and logs. Aats Bay (*900* in part, *907*, *916*, *927*); Augustine Bay (*574*, *579* in part); Brownson Bay (*476*); Exchange Cove (*267*); Hidden Inlet (*58*); Nichols Bay (*369*, *392* in part, *399* in part, *401*); Ratz Harbor (*321*); St. John Harbor (*221*, *250*). New to Alaska.

7. METZGERIA PUBESCENS (Schrank) Raddi

On wet rocks. Hidden Inlet (*80*). Previously reported by Stephani (**14**, p. 98) and Miss Cooley (**1**, p. 247).

8. PALLAVICINIA FLOTOWIANA (Nees) Lindb.

On moist soil. Seward (*Rigg 1216*). Previously reported by the writer (**3**, p. 291, as *P. hibernica*).

9. PELLIA NEESIANA (Gottsche) Limpr.

On wet soil. Aats Bay (*901*); Baranof (*1080*); Ketchikan (*10*, *17*); Ratz Harbor (*301*); St. John Harbor (*241*); Swifts Cannery (*704*). Previously reported by the writer (**3**, p. 293).

JUNGERMANNIACEAE

10. GYMNOMITRIUM OBTUSUM (Lindb.) Pears.

On rocks. Brownson Bay (*481*); Nichols Bay (*380*). Previously reported by the writer (**3**, p. 293, *pl. 16, f. 1–3*).

11. MARSUPELLA EMARGINATA (Ehrh.) Dumort.

On wet rocks, soil, and decayed logs. Ketchikan (*9*); Nichols Bay (*373*); Port Malmsbury (*993*); St. John Harbor (*223*, *234*, *251*); Verdure Creek (*35*). Previously reported by the writer (**3**, p. 295; **4**, p. 130) and Howe (**8**, p. 102).

12. NARDIA SCALARIS (Schrad.) S. F. Gray

On wet soil. Ketchikan (*502*); Port Malmsbury (*992*); Shuyak Island (*Rigg 1230*). Previously reported by the writer (**3**, p. 296).

13. GYROTHYRA UNDERWOODIANA M. A. Howe

On wet rocks. Augustine Bay (*545*). New to Alaska.

14. JUNGERMANNIA ATROVIRENS Schleich.

On wet rocks. Port Alice (*730*). Previously reported by the writer (**3**, p. 299; **4**, p. 131).

15. JUNGERMANNIA CORDIFOLIA Hook.

On a log in a streamlet. Port San Antonio (*601*). Previously reported by Stephani (**14**, p. 97) and Howe (**8**, p. 102).

The specimens in the present collection are sterile and are aberrant in having better developed trigones than is usual in the species. In this respect they agree with the specimens cited by Howe.

16. LOPHOZIA FLOERKEI (Web. & Mohr) Schiffn.

In a swampy place. Baranof (*1084* in part). Previously reported by the writer (**3**, p. 304; **4**, p. 131) and Howe (**8**, p. 103).

17. LOPHOZIA INCISA (Schrad.) Dumort.

On decayed logs. Lake Bay (*208*); Nichols Bay (*402*); Ratz Harbor (*307*); Port San Antonio (*623*); Sitklan Island (*44*); Swifts Cannery (*692*, *702*); Tam Gas Harbor (*146*). Previously reported by the writer (**3**, p. 303; **4**, p. 131).

18. LOPHOZIA INFLATA (Huds.) M. A. Howe

In pools. Nichols Bay (*388*); St. John Harbor (*227*). Previously reported by the writer (**3**, p. 304; **4**, p. 131).

19. LOPHOZIA PORPHYROLEUCA (Nees) Schiffn.

On logs and moist soil. Exchange Cove (*275*); Port Chatham (*Rigg 1225* in part); Swifts Cannery (*759*); Taku Inlet (*1027*), Not before reported from Alaska. The species was collected, however, by Miss Lois Clark at Douglas, in October, 1908.

20. LOPHOZIA QUINQUEDENTATA (Huds.) Cogn.

On earth. Mitrofania Bay (*Rigg 1233*). Previously reported by the writer (**3**, p. 304).

21. SPHENOLOBUS EXSECTUS (Schmid.) Steph.

On earth. Mitrofania Bay (*Rigg 1219* in part). New to Alaska.

22. SPHENOLOBUS MINUTUS (Crantz) Steph.

On rocks. Verdure Creek (*31*). Previously reported by Stephani (**12**, p. 97, as *Jungermannia minuta*), the writer (**3**, p. 305, as *Lophozia minuta*) and Howe (**8**, p. 103, as *L. minuta*).

23. ANASTREPTA ORCADENSIS (Hook.) Schiffn.

Jungermannia orcadensis Hook. Brit. Jung. *pl. 17*. 1814.
Mesophylla orcadensis Dumort. Hep. Europ. 130. 1874.
Jungermannia (*Anastrepta*) *orcadensis* Lindb.; Lindberg & Arnell, Kgl. Svenska Vet. Akad. Handl. 23^5: 40. 1889.
Anastrepta orcadensis Schiffn.; Engler & Prantl, Nat. Pflanzenfam. 1^3: 85. 1893.

In a swampy place. Baranof (*1084* in part). New to America.

The geographical distribution of *Anastrepta orcadensis* presents several points of interest. In Europe it is more or less abundant in the higher mountain ranges, reaching lower altitudes in the British Isles, the Faroe Islands, and Scandinavia. Then it reappears in the Himalayas, in China, and in the Hawaiian Islands. Its discovery in Alaska marks a very noteworthy extension of its known range.

Although Lindberg knew the plant from sterile material only, he pointed out the fact that it differed markedly from the species of *Jungermannia*, subgenus *Eujungermannia*, section *Lophozia*—the genus *Lophozia* of most recent writers—and proposed the new section *Anastrepta* for its reception. This section was soon raised by Schiffner to generic rank, although he was still in ignorance of the reproductive branches. At the time of its publication as a genus *Anastrepta* was monotypic, but Stephani has recently transferred to it two additional species from the Straits of Magellan.

The habit of *Anastrepta* differs strongly from that of *Lophozia*, the stems being erect or ascending and forming loose tufts. The

leaves are succubous and bidentate at the apex, much as in *Lophozia*, subgenus *Dilophozia* K. Müll., but the line of attachment is strongly arched, the leaves being slightly decurrent at the postical base. In this respect the genus shows a relationship to *Plagiochila*. The leaves in *A. orcadensis* are imbricated and spread somewhat widely from the stem. The margin at the antical base is more or less revolute but this condition is much more pronounced at the postical base, the narrow revolute portion being quite unlike anything found in *Lophozia*. The apical sinus and lobes are subject to considerable variation. The sinus is always shallow and is sometimes scarcely apparent, the apex of the leaves appearing truncate. The lobes are sometimes nothing more than rounded corners and are usually rounded or very obtuse even when more distinct. Occasionally, however, they are more sharply pointed. The leaf-cells are small, measuring about 16 μ in diameter in the middle of the leaf and 20×16 μ at the base. Their walls are thin and their small trigones have concave or straight sides. The cuticle is smooth.

Soon after Schiffner published *Anastrepta* as a genus the androecia and perianths were described by Jörgensen from Norwegian material, and K. Müller has recently added an account of the sporophyte from specimens collected by J. Velenovský near Prague. According to Jörgensen* the perianths are slightly laterally compressed, but K. Müller was unable to confirm his observations and describes the perianths as bluntly four-angled in the upper part and plicate at the contracted mouth. The perianths, therefore, are essentially like those of *Lophozia*, and the same thing may be said of the androecia and sporophytes. At the same time the peculiar features of the vegetative organs are sufficient to justify the maintenance of *Anastrepta* as a genus. The specimens from Baranof are not abundant and lack sexual organs. Some of the leaves, however, bear clusters of the characteristic two-celled gemmae, which are deeply pigmented with purple and often show an angular outline. K. Müller† and Macvicar‡ may be consulted for descriptions and figures of the

* Bergens Mus. Aarb. 1894–95[18]: 3–5. *pl. 1;* 1901[4]: 3–5. *pl. 1.*

† Rabenhorst's Kryptogamen-Flora **6**: 753. *f. 336, 337.* 1910.

‡ Student's Handb. British Hepat. 213. *f. 1–4.* 1912.

species, while Schiffner* has given a full account of its more important forms.

24. PLAGIOCHILA ASPLENIOIDES (L.) Dumort.

On damp rocks, soil, and logs. Augustine Bay (*544*); Hidden Inlet (*60*); Lake Bay (*205*); Mitrofania Bay (*Rigg 1219* in part); Port Alice (*724, 728* in part); Shipley Bay (*767, 778*); St. John Harbor (*230, 246*); Swifts Cannery (*691*); Tam Gas Harbor (*130*). Previously reported by Coville (**2**) and the writer (**3**, p. 305; **4**, p. 131).

25. **Plagiochila alaskana** sp. nov.

On logs. Nichols Bay (*392* mostly, *399* mostly). No. 399 may be designated the type. The accompanying species are *Metzgeria conjugata* (mixed with both numbers), *Diplophyllum albicans* (mixed with *392*), and *Frullania nisquallensis* (mixed with *399*).

Yellowish or brownish green, not glossy, growing in compact tufts: stems mostly 2–3 cm. long and about 0.15 mm. in diameter, rigid, ascending, simple or sparingly and irregularly branched, the branches all intercalary, obliquely spreading, similar to the stems: rhizoids sometimes present near the base: leaves alternate, more or less imbricated, spreading at an angle of 45 degrees or less, postically secund and often deflexed in the outer part, more or less convex, ovate, mostly 1–1.4 mm. long (from middle of base to apex) and 0.7 mm. wide, long-decurrent antically, less decurrent postically, the decurrent portions narrow and the line of attachment strongly arched; antical margin revolute to about the middle, straight or slightly outwardly curved (on explanate leaves), entire to about the middle, sharply dentate or ciliate-dentate in the outer part; postical margin more strongly outwardly curved, sometimes slightly dilated toward the base, sharply dentate or ciliate-dentate; apex broad and rounded with teeth like those on the postical margin; total number of teeth mostly twenty to twenty-five, unequal, three to six cells long, one to three cells wide at the base; leaf cells plane, averaging 14 μ in the apical portion, 21×14 μ in the middle, and 40×14 μ at the base, walls more or less thickened with well-developed triangular trigones, sometimes with bulging sides, and rare intermediate thickenings, coalescence between thickenings frequent, especially in median and basal regions, cuticle smooth: underleaves very minute:

* Ber. naturw.-med. Ver. Innsbruck **31** (Beilage): 22–31. 1908.

inflorescence dioicous: ♀ inflorescence borne on the stem or on a leading branch, often with one or two subfloral innovations; bracts similar to the leaves and intergrading into them; innermost bracts about 1.5 mm. long and 1 mm. wide, the marginal teeth about twenty-five, usually longer than those on the leaves, an occasional tooth sometimes attaining a length of seven or eight cells; perianth narrowly obovate, about 2.7 mm. long and 1 mm. wide, strongly compressed, the sharp keels destitute of wings, sharply and densely ciliate at the truncate mouth: ♂ inflorescence and sporophyte not seen. (PLATE 21, FIGS. 1–6.)

This and the following species are closely allied but have no near relatives among the other species known from North America. Some of the East Indian species resemble them to a certain extent, and the same thing is true of various Andean species. The writer finds it impossible, however, to refer them to any described species and therefore proposes them as new, in spite of the fact that the species of *Plagiochila* are already so numerous and so incompletely understood.

In *P. alaskana* the following characters are perhaps the most important from a diagnostic standpoint: the simple or sparingly branched stems; the intercalary branches: the postically secund and often deflexed leaves; the narrowly arched line of attachment, the antical base being remarkably long-decurrent; the dentate or ciliate-dentate leaf-margins; the group of elongated cells at the base of the leaves; the exalate perianths. These peculiarities would place the species in Schiffner's section *Denticulatae*,* a well-marked group which Stephani unfortunately does not recognize.

Among the species of this group growing in tropical Asia mention may be made of two, *P. renitens* Nees,† of Java, Sumatra, and India, and *P. trapezoidea* Lindenb.,‡ of Java. In both of these species the characters just enumerated for *P. alaskana* are more or less clearly exhibited. Both species, however, are considerably larger, the stems sometimes attaining a length of 10 cm. and the leaves a length of 2.5 mm. or more. The leaves, moreover, are

* Die Hepaticae der Flora von Buitenzorg. Fl. Buitenzorg 4: 106. 1900.

† Lindenberg, Monogr. Hepat. Gen. *Plagiochilae* 90. *pl. 17, f. 1–6.* 1844 (=*Jungermannia renitens* Nees, Enum. Plant. Crypt. Javae 1: 76. 1830).

‡ *L. c.* 112. *pl. 22, f. 1–18.* 1844.

relatively broader, the ratio of width to length being 0.9 instead of only 0.7–0.75 as in *P. alaskana*. The greater relative breadth is due largely to a strong dilation at the postical base. The marginal teeth in the two Asian species are much like those in *P. alaskana* but usually number from thirty to forty. In *P. renitens* the decurrent portion at the antical base is entire, but in *P. trapezoidea* it is distinctly dentate and the species is further remarkable on account of the short and narrow lamina or paraphyllium which runs parallel with the decurrent portion and is situated in its near vicinity. In *P. renitens* the deflexed and postically secund habit is particularly well marked. The cells in both Asian species are somewhat larger than in *P. alaskana*, those in the apical portion measuring about 20 μ in diameter those in the middle about 30×20 μ, and the elongated basal cells about 60×20 μ; the trigones, especially in *P. trapezoidea*, are more clearly defined than in *P. alaskana*, coalescence being less prevalent.

To a considerable extent the section *Denticulatae* of Schiffner corresponds with the section *Heteromallae* of Spruce.* Of this group, to which Spruce refers thirteen South American species, the following may be profitably compared with *P. alaskana: P. pachyloma* Tayl.,† *P. oxyphylla* Spruce,‡ and *P. fragilis* Tayl.,§ all of Ecuador. These three species show most of the characters emphasized under *P. alaskana*, although the elongation of the basal cells is not apparent in either *P. pachyloma* or *P. oxyphylla*, nor is the deflexed and postically secund habit always marked.

In *P. pachyloma* the leaves are almost as broad as long and measure about 2.2 cm. in length in the specimens studied by the writer, although Spruce gives a length of 2.75 mm. and Stephani a length of 3 mm. The postical base is strongly dilated, the antical margin is entire except near the apex, while the postical margin and the apical region are sharply spinose-dentate. The total number of teeth being about thirty. The species is peculiar in the brownish pigmentation of the teeth, in the strongly thickened

* Hep. Amaz. et And. 458. 1885.
† Jour. Bot. 5: 267. 1846.
‡ Hep. Amaz. et And. 480. 1885.
§ Jour. Bot. 7: 284. 1848.

walls of their elongated cells, and in the elongated cells with thickened walls which form a border along the antical margin.

In *P. oxyphylla* the leaves are relatively narrower than in *P. pachyloma*, measuring about 2×1.6 mm. The antical margin is entire, the apex is usually dipped with a single acuminate tooth, although a second smaller tooth is sometimes present at the antical base of the apical tooth, or the apex may even be subequally bispinose. The postical margin bears from fifteen to eighteen sharp teeth or cilia, which are crowded toward the base and more scattered toward the apex.

In *P. fragilis* the leaves are always deflexed and postically secund, and the basal leaf-cells are always distinctly elongated. When well developed the leaves measure about 1.7 mm. in length and 1.4 mm. in width, ratio of width to length thus being about 0.8. The antical leaf-margin is entire, the dilated postical margin bears from twelve to sixteen spinose teeth, and the apex is usually unequally bidentate, the larger tooth being longer than the postical teeth. In some cases there is only one apical tooth. The leaf-cells in *P. fragilis* measure about 20 μ in diameter at the apex, 30×20 μ in the middle, and 50×20 μ in the basal region. The trigones, separated from one another by narrow pits, are unusually well developed, making the cell-cavities distinctly stellate; coalescence between trigones is not infrequent.

26. **Plagiochila Fryei** sp. nov.

On a dry tree base. Augustine Bay (*579*). A slight admixture of *Metzgeria conjugata* is present.

Yellowish or brownish green, not glossy, growing in compact tufts: stems mostly 2–3 cm. long and 0.15 mm. in diameter, rigid, ascending, mostly simple, rarely with an occasional branch, the branches all intercalary, obliquely spreading, similar to the stems: rhizoids sparingly produced: leaves alternate, more or less imbricated, spreading at an angle of 45 degrees or less, postically secund and often deflexed in the outer part, more or less convex, orbicular-ovate to orbicular (exclusive of the decurrent portions), about 1.4 mm. long (when well developed) and 1.2–1.4 mm. wide, long-decurrent antically, less decurrent postically, the decurrent portions narrow, line of attachment strongly arched; antical margin revolute to about the middle, outwardly curved (on explanate leaves), entire to the middle or beyond, sometimes bearing

one to three broad and short teeth in the outer part; postical margin strongly outwardly curved and dilated toward the base, sharply spinose-dentate; apex broad and rounded with teeth like those along the postical margin; total number of teeth mostly twelve to fifteen, unequal and variable, pointing in various directions, mostly acuminate but sometimes merely acute, mostly two to six cells long and one to five cells wide at the base; leaf-cells plane, averaging 14 μ in the apical portion, 22×14 μ in the middle, and 40×14 μ at the base, walls more or less thickened with well-developed but poorly defined trigones, the sides being straight or concave; coalescence between the trigones frequent especially in the median and basal portions, cuticle smooth: underleaves minute: remaining parts not seen. (PLATE 21, FIGS. 7–9.)

It will be seen from the above description that *P. Fryei* and *P. alaskana* are very closely related species and that most of the vegetative characters emphasized under *P. alaskana* are exhibited equally well by *P. Fryei*. In spite of these facts it still seems justifiable to consider the two plants distinct. The differences between them are found in the form of the leaves and in the peculiarities of the marginal teeth. The leaves of *P. alaskana* are relatively narrower than in *P. Fryei*, the ratio of width to length being only 0.7–0.75 instead of 0.85–1.. As in the two species of tropical Asia, discussed under *P. alaskana*, the greater relative breadth in *P. Fryei* is due to the marked dilation of the postical base, a feature which appears to be constant. The marginal teeth in *P. alaskana* are more numerous than in *P. Fryei* and tend to be narrower and more sharply pointed; they extend farther back toward the antical base and usually spread out widely from the margin, instead of being variously directed. The cell-structure is very much the same in the two species, the middle lamellae are usually discernible, and the cell-measurements are practically identical. In *P. alaskana* the trigones are somewhat more distinct and sometimes have bulging sides; in *P. Fryei* the trigones, although well-developed, more frequently coalesce, thus making the walls appear uniformly thickened, and their sides are concave or straight. These differences, however, can not be regarded as very important in such a genus as *Plagiochila*, where the thickenings in the walls are subject to considerable variation.

The Asian and South American species contrasted with *P. alaskana* may be considered in connection with *P. Fryei* also.

They approach this species rather more closely than they do *P. alaskana* in having broader leaves more constantly and more strongly dilated at the postical base, but most of the other differences which distinguish them from *P. alaskana* would distinguish them from *P. Fryei* as well.

27. MYLIA ANOMALA (Hook.) S. F. Gray

In a bog. Metlakatla (*105*). New to Alaska.

28. MYLIA TAYLORI (Hook.) S. F. Gray

On logs. Augustine Bay (*Foster 575; 760*); Ketchikan (*542*); Morse Cove (*440*); Nichols Bay (*370*); Port Alice (*Foster 787* in part); Port Chatham (*Rigg 1225* in part); Port Antonio (*608*); Saltery Cove (*327*); St. John Harbor (*248*). Previously reported by the writer (**3**, p. 305).

29. LOPHOCOLEA CUSPIDATA (Nees) Limpr.

On a tree. Swifts Cannery (*686*). Previously reported by the writer (**3**, p. 306).

30. CHILOSCYPHUS PALLESCENS (Ehrh.) Dumort.

On a wet log. Aats Bay (*911*). New to Alaska.

31. CHILOSCYPHUS RIVULARIS (Schrad.) Loeske

On wet rocks and soil. Egg Harbor (*945*); Saltery Cove (*333*). Previously reported by Miss Cooley (**1**, p. 246, as *Ch. polyanthus*, var. *rivularis*).

32. GEOCALYX GRAVEOLENS (Schrad.) Nees

On moist soil. Snug Harbor (*Rigg 1222*). New to Alaska.

33. CEPHALOZIA BICUSPIDATA (L.) Dumort.

On logs, rocks, and soil, often in very damp localities. Aats Bay (*918*); Augustine Bay (*572, 585, 587, 588*); Exchange Cove (*263, 266, 272*); Ketchikan (*498*); Morse Cove (*454*); Nichols Bay (*381, 403*); Port San Antonio (*622*); Ratz Harbor (*308*); Snug Harbor (*Rigg 1217*); St. John Harbor (*228*); Swifts Cannery (*695, 703, 718*); Tam Gas Harbor (*137, 149*). Previously reported by the writer (**3**, p. 306).

34. CEPHALOZIA LEUCANTHA Spruce

On earth. Port Chatham (*Rigg 1225* in part). Previously reported by the writer (**3**, p. 306, *pl. 42, f. 18–26*).

35. CEPHALOZIA MEDIA Lindb.

On rocks and soil. Augustine Bay (*589, 595*); Port San Antonio (*610*); Ratz Harbor (*300*). Previously reported by Miss Cooley (**1**, p. 246, as *C. multiflora*), Coville (**2**, as *C. multiflora*), and the writer (**3**, p. 306).

36. CEPHALOZIELLA BYSSACEA (Roth) Warnst.

On humus. Woewodski Island (*Foster 966*). Previously reported, as *Cephalozia divaricata*, by Coville (**2**) and the writer (**3**, p. 308; **4**, p. 131).

37. CALYPOGEIA NEESIANA (Massal. & Carest.) K. Müll.

On logs. Augustine Bay (*594*); Egg Harbor (*943*). Not before reported from Alaska. A specimen, however, from Columbia Fiord, Prince William Sound, *Coville & Kearney 1399*, belongs here. Reported by the writer (**3**, p. 308, as *Kantia Trichomanis*).

38. CALYPOGEIA TRICHOMANIS (L.) Corda

On logs and wet soil. Morse Cove (*444*); Port San Antonio (*624*); Verdure Creek (*34*). Previously reported, as *Kantia Trichomanis*, by Miss Cooley (**1**, p. 246), Coville (**2**), and the writer (**3**, p. 308).

39. BAZZANIA PEARSONI Steph.

Bazzania Pearsoni Steph. Hedwigia **32**: 212. 1893.

Mastigobryum Pearsoni Steph. Bull. Herb. Boissier II. **8**: 852. 1908.

Pleuroschisma Pearsoni K. Müll. Rabenhorst's Kryptogamen-Flora 6^2: 272. 1913.

Among mosses at the base of a tree. Metlakatla (*109* in part, *113*). New to America.

The discovery of this very rare European species in Alaska is of much interest from the standpoint of geographical distribution. It was based on material collected at Killarney, Ireland, by Stewart

and Holt in 1885. It was found a second time at Slievemore, Achill Island, off the western coast of Ireland, by Jones and Duncan in 1911. No other stations have been reported. Through the kindness of Miss Haynes the writer has been enabled to compare material from both Irish stations with the specimens from Alaska, and finds that they agree in all essential respects. In No. 109 the species grew mixed with *Herberta adunca*.

In size and general habit *B. Pearsoni* bears a strong resemblance to the typical forms of *B. tricrenata*. The leaves, especially when dry, are umbricated and strongly decurved in both species, while the apex is usually bi- or tridentate with variable teeth. The distinctive characters of *B. Pearsoni* are the following: the strongly dilated antical portion of the leaves, the lack of distinct teeth on the underleaves, the very large trigones in the cells of both leaves and underleaves. The antical portion is so strongly dilated that it makes the leaf arch considerably beyond the axis and forms a cordate expansion at the base. The trigones in typical cases are separated by narrow pits with straight sides, the cell-cavities being distinctly stellate; the sides of the trigones are strongly convex or truncate, and coalescence of trigones is not infrequent. The middle lamellae are very distinct. The underleaves are contiguous to imbricated and are rounded or subcordate at the base; in outline they vary from orbicular to broadly ovate, the lateral margins are somewhat outwardly curved and are often reflexed at the base, and the apex is truncate or slightly retuse. Full descriptions of *B. Pearsoni*, with figures, may be found in Pearson's Hepaticae of the British Isles (p. 133, *pl. 50*) and in Macvicar's Student's Handbook of British Hepatics (p. 319, *f. 1–4*).

Among exotic species which are allied to *B. Pearsoni*, the Hawaiian *B. Didericiana* (Gottsche) Steph.* may be particularly noted. In this species, which is about as large as *B. Pearsoni*, the leaves are much less convex and are also less dilated in the antical portion, while the underleaves are almost constantly toothed at the truncate apex, the teeth being very variable. The leaves

* See C. M. Cooke, Jr. Trans. Connecticut Acad. **12**: 15. *pl. 4, f. 1–13*. 1904. In his Species Hepaticarum (Bull. Herb. Boissier II. **8**: 775. 1908) Stephani has changed the name of this species to *Mastigobryum Didrichsenii*.

differ further in the fact that they are less narrow toward the apex. The leaf-cells with their large and strongly developed trigones are much the same in the two species.

40. BAZZANIA TRICRENATA (Wahl.) Trevis.

On rocks and logs. Aats Bay (*908*); Augustine Bay (*543*, *571*, *578*, *590*); Exchange Cove (*278*, *279*); Hidden Inlet (*63*, *86*); Lake Bay (*210*); Morse Cove (*452*); Nichols Bay (*368*); Port Alice (*Foster 785*, *Foster 786*, *Foster 787* in part); Port Malmsbury (*980*, *982*); Port San Antonio (*606*, *616*, *617*, *645*); Ratz Harbor (*298*); Shipley Bay (*762*, *763*, *774*); Sitklan Island (*47*, *50*); Snug Harbor (*Rigg 1221*); St. John Harbor (*865*); Swifts Cannery (*687*, *690*); Tam Gas Harbor (*119*, *134*, *136*, *148*); Verdure Creek (*23*). Previously reported by Stephani (**14**, p. 97, as *Mastigobryum deflexum*), Miss Cooley (**1**, p. 246, as *Bazzania deflexa*), and the writer (**3**, p. 308, as *B. deflexa*).

41. BAZZANIA TRILOBATA (L.) S. F. Gray

On rocks in woods. Baranof (*1084* in part); Verdure Creek (*21*). New to Alaska and apparently to the Pacific Coast region.

42. LEPIDOZIA FILAMENTOSA (Lehm. & Lindenb.) Lindenb.

On rocks and soil. Augustine Bay (*581*); Port San Antonio (*644*, *Foster 1120*); Shipley Bay (*1124*); Verdure Creek (*30*). Previously reported by Howe (**7**, p. 138) and the writer (**3**, p. 308).

43. LEPIDOZIA REPTANS (L.) Dumort.

On rocks, soil, and logs. Augustine Bay (*595* in part); Baranof (*1088*); Exchange Cove (*271*): Taku Inlet (*1035*). Previously reported by Miss Cooley (**1**, p. 246), Coville (**2**), and the writer (**3**, p. 308).

44. LEPIDOZIA SANDVICENSIS Lindenb.

Lepidozia sandvicensis Lindenb.; G. L. & N., Syn. Hep. 201. 1845. Lindenberg & Gottsche, Sp. Hep. **6**: 12. *pl. 1, f. 1–5*. 1846. C. M. Cooke, Jr., Trans. Connecticut Acad. **12**: 7. *pl. 2, f. 1–12*. 1904.*

* A few synonyms are recorded here.

On soil in very damp woods. Augustine Bay (*684, Foster 2475*); Port San Antonio (*652*). New to America. Heretofore known only from the mountains of the Hawaiian Islands, where it was collected many years ago by Tolmie and more recently by Baldwin.

It may perhaps appear hazardous to refer an Alaskan plant to a species of the Hawaiian Islands, but a careful comparison of the specimens noted above with material collected by Baldwin on the island of Maui has failed to bring to light any essential differences. It should be admitted, however, that *L. sandvicensis* is known from the Hawaiian Islands in sterile condition only and that the Alaskan material is equally destitute of female inflorescences. It is possible, therefore, that the discovery of perichaetial bracts and perianths may bring to light differential characters necessitating the segregation of the American plant as a distinct species.

The description and figures of Lindenberg give a clear general idea of the species, while a number of additional details are supplied by Cooke. *L. sandvicensis* belongs to a fairly well-defined group of *Lepidoziae* which are mostly of tropical distribution. They are characterized by pinnate stems with subdivided branches, the stems being limited in growth and blunt, the branches being likewise limited in growth but tapering out into slender flagella. The branches are of about the same length and give the entire shoot system a loosely plumose appearance. The group is further characterized by very minute leaves and underleaves, which are mostly far apart. Most of the photosynthesis is therefore carried out by the green axes, and the plants, in some cases at least, look almost as if they belonged to the thallose genus *Riccardia*.

In *L. sandvicensis* the main stem is somewhat flattened dorsoventrally, measuring about 0.5×0.3 mm. in section, and is bounded by a layer of short cells arranged in from forty to sixty longitudinal rows. These cells have thickened walls and measure about 20 μ in width. The internal cells average about 15 μ in width and have somewhat thinner walls. Rhizoids are wanting except near the tips of some of the flagelliform branches. The leaves and underleaves are so well described by Cooke that only a few of their more important features need be noted here. The stem leaves are almost transversely attached and extend obliquely outward, scarcely, if at all, projecting beyond the stem. The antical edge

is a little longer than the postical, the leaf thus being slightly unsymmetrical. In well-developed leaves the antical edge is about 0.3 mm. long, the postical about 0.2 mm. and the breadth at the base of the leaf about 0.4 mm. The leaves are normally quadrifid to below the middle with subulate acute lobes, ending in a single cell or in a row of two or three cells, and usually separated by acute sinuses. The underleaves are similar but smaller, being only 0.25 mm. in width. The leaf-cells measure about $30\times22\ \mu$ in the middle of the leaf and have thickened walls with indistinct trigones. The cuticle is smooth throughout.

The specimens from Augustine Bay show male inflorescences and indicate that the species is probably dioicous. The androecia occupy very short postical branches growing in the axils of the underleaves on the main stem. They are not abundant, the highest number observed on an individual stem being five. The concave bracts are crowded and borne in from two to four pairs, each bract enclosing one or two antheridia in its axil. No case of proliferation was observed, a condition apparently associated with the delicacy of the entire inflorescence. The individual bracts are subject to considerable variation in size and complexity. One of the best developed was 0.45 mm. long and 0.6 mm. wide. It was four-lobed to about the middle, the divisions and sinuses being acute. The margins of the divisions, although mostly entire, showed an occasional small tooth formed by a projecting cell. Other bracts showed only three lobes and sometimes the marginal denticulation was more pronounced. A well-developed bracteole measured 0.15 mm. in length and 0.25 mm. in width, and was likewise quadrifid to about the middle with acute entire lobes and sinuses, each lobe being two or three cells long and two cells wide at the base. The cells of both bracts and bracteoles are characterized by thin walls with vague indications of trigones toward the apices of the lobes. In the bracts the cells measure about $30\times24\ \mu$. The antheridia are about 0.15 mm. in diameter.

There is no danger whatever of confusing *L. sandvicensis* with any of the other species of *Lepidozia* now known from the Pacific Coast region of North America. In both *L. reptans* and *L. filamentosa*, which occur in the present collection, the leaves are much larger and are often imbricated, so that the shoots bear no re-

semblance to those of *Riccardia*. In *L. setacea*, reported from Alaska and probably occurring in British Columbia, the plants are much smaller, while the deeply quadrifid, crowded, concave leaves with slender divisions are relatively much larger. Among European species *L. Pearsoni* Spruce,* of the British Isles and Norway, comes somewhat nearer to *L. sandvicensis* on account of its lax habit and distant leaves and underleaves. But in this species the leaves and underleaves are considerably larger than in *L. sandvicensis*, the leaves are occasionally five- or six-lobed, the androecia are usually terminal on long lateral branches and the antheridia occur singly. Since *L. Pearsoni* has been found in company with *Anastrepta orcadensis* there is a possibility that it may yet be discovered in Alaska. At the present time the perianths are unknown, although the female inflorescence has been described.

45. BLEPHAROSTOMA TRICHOPHYLLUM (L.) Dumort.

On soil, rocks, and logs. Aats Bay (*932*); Augustine Bay (*573*); Hidden Inlet (*67*); Sitklan Island (*43*); Verdure Creek (*37*). Previously reported by Rothrock (**13**, as *Jungermannia trichophylla*), Coville (**2**), and the writer (**3**, p. 308; **4**, p. 132).

46. ANTHELIA JULACEA (L.) Dumort.

On rocks. Port Malmsbury (*986*). Previously reported by the writer (**3**, p. 309; **4**, p. 132).

47. HERBERTA ADUNCA (Dicks.) S. F. Gray

On trees and rocks. Aats Bay (*925*); Augustine Bay (*561*, *Foster 677*); Brownson Bay (*470*, *Foster 517*); Metlakatla (*Wylie 76*, *Wylie 97*, *109* in part); Morse Cove (*446*); Nichols Bay (*384*); Port San Antonio (*605*, *649*); Ratz Harbor (*309*); Saltery Cove (*320*). Previously reported by Underwood (**16**, p. 366), Merriam (**9**), and the writer (**3**, p. 309).

48. PTILIDIUM CALIFORNICUM (Aust.) Underw. & Cook

On trees, bushes, and logs. Hidden Inlet (*92*); Port Malmsbury (*980*); Shipley Bay (*Foster 779*); Verdure Creek (*26*). Previously reported by the writer (**3**, p. 309).

* Jour. Bot. **19**: 34. 1881. See also Pearson, Hep. British Isles 121. *pl. 45*. 1900; Macvicar, Student's Handb. British Hepat. 325. *f. 1–5*. 1912; and K. Müller, Rabenhorst's Kryptogamen-Flora 6^2: 284. *f. 86*. 1914.

49. PTILIDIUM CILIARE (L.) Nees

On rocks. Taku Inlet (*1026*). Previously reported by Stephani (**14**, p. 97) and the writer (**3**, p. 309; **4**, p. 132).

50. PTILIDIUM PULCHERRIMUM (Web.) Hampe

On logs and stumps. St. John Harbor (*245*); near Wrangell (*Foster 1122*). Previously reported by Stephani (**15**, vol. 4, p. 43).

51. DIPLOPHYLLUM ALBICANS (L.) Dumort.

On logs, trees, and soil. Calder (*835*); Brownson Bay (*474*); Exchange Cove (*276*); Lake Bay (*197, 211*); Morse Cove (*439*); Port San Antonio (*647*); Shuyak Island (*Rigg 1227*); Swifts Cannery (*696*); Tam Gas Harbor (*128*). Previously reported by Rothrock (**13**, as *Jungermannia albicans*) and the writer (**3**, p. 309, as *Diplophylleia albicans*).

52. DIPLOPHYLLUM OVATUM (Dicks.) Steph.

On logs and trees. Brownson Bay (*473*); Nichols Bay (*386*); Port Malmsbury (*989* in part). Previously reported by the writer (**3**, p. 305, as *Lophozia ovata*).

53. DIPLOPHYLLUM PLICATUM Lindb.

On trees and rocks. Baranof (*1084* in part); Exchange Cove (*274*); Ratz Harbor (*293*); Saltery Cove (*331*). Previously reported by the writer (**3**, p. 309, *pl. 17, 18, f. 27–35*, as *Diplophylleia plicata*).

54. DIPLOPHYLLUM TAXIFOLIUM (Wahl.) Dumort.

On rocks and logs. Deweyville (*Foster 789*); Seward (*Rigg 1228*); St. John Harbor (*243*); Verdure Creek (*27*). Previously reported by Gottsche, Lindenberg, and Nees von Esenbeck (**5**, p. 76, as *Jungermannia albicans*, var. *taxifolia*), Merriam (**9**), and the writer (**3**, p. 309, as *Diplophylleia taxifolia;* **4**, p. 132, under the same name).

55. SCAPANIA BOLANDERI Aust.

On logs, trees, and rocks. Augustine Bay (*582*); Brownson Bay (*469*); Hidden Inlet (*79, 89, 90*); Lake Bay (*207, 209, 213*); Morse Cove (*441, 442, 443*); Port Alice (*Foster 787*); Port Chatham

(*Rigg 1226, 1234*) Port Malmsbury (*984*); Port San Antonio (*600, 604, 613*); Ratz Harbor (*295, 304*); Sitklan Island (*48*); Snug Harbor (*Rigg 1218*); St. John Harbor (*232*); Swifts Cannery (*698, 712*); Tam Gas Harbor (*117, 118, 124, 125*); Verdure Creek (*22*). Previously reported by Stephani (**14**, p. 96, *pl. 3, f. 9*, as *Scapania albescens*), Pearson (**12**, p. 14), the writer (**3**, p. 311), and K. Müller (**11**, p. 186).

56. SCAPANIA CORDIFOLIA K. Müll.

Scapania cordifolia K. Müll. Bull. Herb. Boissier II. **3**: 38. 1903. Nova Acta Kaiserl. Leop.-Carol. Acad. **88**: 91. *pl. 7b, f. 1–7*. 1905.

Scapania paludosa papillosa K. Müll.; L. Clark, Bull. Torrey Club **36**: 306. *pl. 20, f. 12–17*. 1909.

On wet rocks and soil, often in running water. Augustine Bay (*593*); Morse Cove (*424*); Port Malmsbury (*999, 1000*); Saltery Cove (*328*); St. John Harbor (*218*). Previously reported by K. Müller (**10**, p. 38), as noted above. The following stations to the southward of Alaska may likewise be quoted: near Skidegate, Queen Charlotte Islands, British Columbia, *W. Spreadborough 83171*, July, 1910; near Hume's Glacier, Queets River valley, Olympic Mountains, Washington, *T. C. Frye 88*, August, 1907 (type of *S. paludosa papillosa*).

The present species was based on Alaska material collected at Columbia Fiord by Coville and Kearney, while members of the Harriman Expedition (No. 1383). In the writer's account of the Hepaticae of this expedition these specimens were referred to *S. undulata*, a species then understood in a much broader sense than at the present time (**3**, p. 365). In proposing *S. cordifolia* as a new species Müller spoke of the great diversity which he found between sterile plants and those bearing perianths, and he emphasized the fact that the fertile plants were scarcely distinct from *S. dentata*, a species not definitely known from America at that time but since then reported from numerous scattered localities. The writer now finds, upon examining Coville and Kearney's material again, that some of the perianth-bearing plants agree fully with the sterile plants of Müller's description, and that the discrepancies between sterile and fertile plants which he em-

phasizes do not actually exist. It would appear, in fact, that what he considered to be fertile material of *S. cordifolia* is really *S. dentata* and that *S. cordifolia*, as originally understood, was a composite species. This being the case two courses are possible. *S. cordifolia* might be regarded as a simple synonym of *S. dentata*, since the fertile plants of *S. cordifolia*, as understood by Müller, belong to *S. dentata;* or the name *S. cordifolia* might be retained for the sterile plants which Müller studied. It is evident that he laid most stress on these sterile plants and that he drew all of his figures from them except figure 7. The writer suggests, therefore, that the second course be followed and that the species *S. cordifolia* be retained with emended characters.

The plants of *S. cordifolia* are robust and more or less pigmented with purplish red. The leaves are imbricated and are especially remarkable on account of their very short and usually arched keels. The antical lobe spreads obliquely while the postical keel extends at almost a right angle from the stem. Both lobes are strongly dilated just beyond the keel, thus giving the leaf a cordate appearance. Both lobes are minutely and sharply denticulate, and most of the teeth are unicellular, although an occasional tooth may be two cells long. In some cases both lobes are abruptly and narrowly decurrent, but this condition is by no means constant, some of the leaves being only slightly or not at all decurrent. The leaf-cells are subject to considerable variation in size. In one case the cells at the apex of the postical lobe were found to measure about 16 μ in diameter, those in the middle about 30×24 μ, and those at the base about 40×24 μ. In other cases the median and basal cells were only 18 μ wide, and the measurements given by Müller show further slight differences. Along the margin of the lobes the cell walls appear to be uniformly thickened with poorly developed trigones, but toward the middle the deeply pigmented and clearly defined trigones usually form a conspicuous feature of the cells. Even here, however, the trigones are not always distinct and the walls may appear to be of about the same thickness throughout. The cuticle is distinctly verruculose.

The perianths are borne on the main stems or on leading branches, and the bracts are much like the leaves. The innermost bracts differ in having a slightly longer keel and more obliquely

spreading lobes, and in lacking the cordate dilations so marked on both lobes of typical leaves at the end of the keel. In one inflorescence studied particularly the antical lobe was ovate, and measured 1.6×1.2 mm. The apex was very bluntly pointed and the margin, throughout the greater part of its length, bore scattered, short, sharp teeth, each consisting usually of a single cell. The postical lobe was oblong-ovate and measured 2.8×1.5 mm. The apex was more rounded and the margin like that of the antical lobe. The perianth was obovate with a broad truncate mouth and measured 3×1.8 mm. The mouth bore about fifty teeth, variously directed and irregularly scattered, each being one or two cells long. None of the inflorescences studied had been fertilized, so that the characteristics of the sporophyte are still unknown.

In his original description, Müller compares *S. cordifolia* with *S. dentata* and *S. uliginosa*. As emended above the plant is evidently much closer to *S. uliginosa* than to *S. dentata*, and shows further a marked resemblance to certain forms of *S. paludosa* K. Müll. The writer, in fact, would consider the var. *papillosa* of *S. paludosa* a synonym of *S. cordifolia*, as indicated above. In both *S. uliginosa* and *S. paludosa* the keels of the leaves are short and usually strongly arched, the lobes are more or less dilated just beyond the end of the keel, and both lobes are more or less decurrent at the base, the decurrence sometimes being very strongly pronounced. In *S. cordifolia* the first two of these features are exhibited in a marked degree, but the third feature is sometimes less conspicuous and may be lacking altogether as Müller's description indicates. *S. uliginosa* is distinguished at once by the fact that the margins of the leaves are entire throughout, although the mouth of the perianth occasionally bears a few scattered teeth. *S. paludosa* is distinguished by its paler color and more delicate texture, the walls of the leaf-cells being only slightly thickened, by its more distant leaves, by the entire margins of its antical lobes, and by the less marked denticulation of its postical lobes.

57. SCAPANIA DENTATA Dumort.

On wet rocks, often in running water. Aats Bay (*906*); Augustine Bay (*540*); Mitrofania Bay (*Rigg 1231*); Port San Antonio (*603*); Saltery Cove (*323*). See notes under *S. cordifolia*, where *S. dentata* is reported for the first time from Alaska.

58. SCAPANIA IRRIGUA (Nees) Dumort.

On moist earth. Mitrofania Bay (*Rigg 1232*); the specimens are scanty and not altogether typical. Previously reported by the writer (**3**, p. 312) and K. Müller (**11**, p. 80).

59. SCAPANIA NEMOROSA (L.) Dumort.

On rocks and soil. Aats Bay (*912, 938*); Morse Cove (*435*); Port Alice (*Foster 784*). Previously reported by Rothrock (**13**, as *Jungermannia nemorosa*), Stephani (**14**, p. 97), and Miss Cooley (**1**, p. 247).

60. SCAPANIA ULIGINOSA (Sw.) Dumort.

In running water. Ketchikan (*504*). New to Alaska.

61. SCAPANIA UMBROSA (Schrad.) Dumort.

On logs and trees. Calder (*827* in part); Ratz Harbor (*305*); Swifts Cannery (*Foster 761*). Previously reported by the writer (**3**, p. 312).

62. SCAPANIA UNDULATA (L.) Dumort.

On wet rocks and soil, often in running water. Ketchikan (*3*); Morse Cove (*438*); Port Malmsbury (*978, 997*); Port San Antonio (*599*); Snug Harbor (*Rigg 1220*); Swifts Cannery (*688*). Previously reported by the writer (**3**, p. 311; **4**, p. 131) and Howe (**8**, p. 104).

63. RADULA BOLANDERI Gottsche

On rocks, trees, and logs. Augustine Bay (*546, 580, 586, Foster 758*); Deweyville (*Foster 1123*); Exchange Cove (*260*); Hidden Inlet (*73*); Ratz Harbor (*297, 312*); Shipley Bay (*Foster 788*). Previously reported by the writer (**3**, p. 312; **4**, p. 132).

Whether the *Radula arctica* of Stephani (**14**, p. 98, *pl. 3, f. 11*) is to be considered a synonym of *R. Bolanderi* is still a matter of some doubt. *R. arctica* was based on sterile material collected by the Krause brothers at Chlowak and Chilcoot (No. 17). On the basis of Stephani's original description and figure Howe (**7**, p. 159, footnote) suggests that it probably represents a juvenile condition of *R. Bolanderi*. Stephani, however, does not accept this suggestion and still maintains that *R. arctica* is a valid species

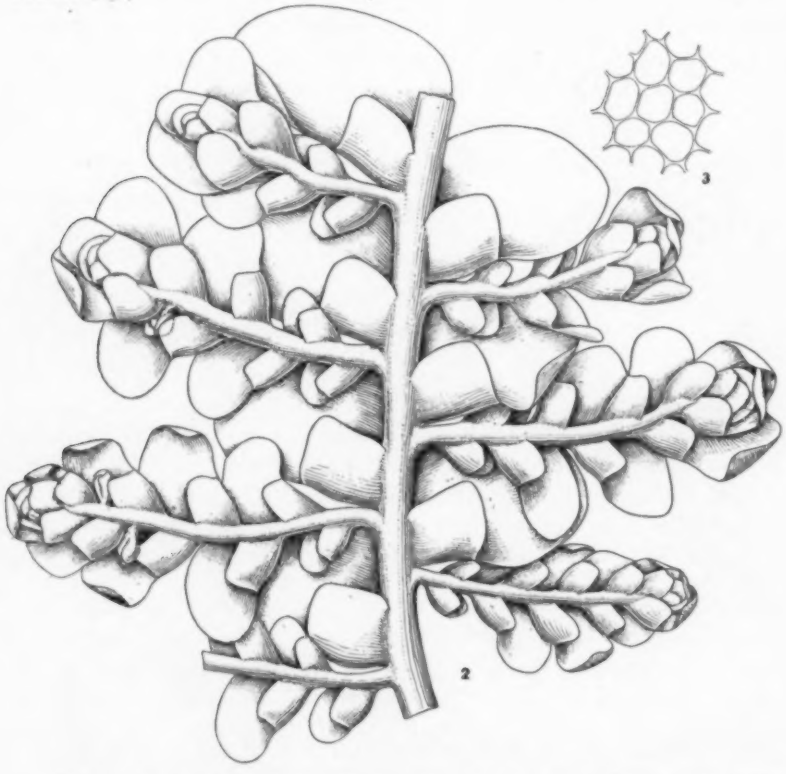
(3, vol. 4, p. 220, 1910). He states that the material of *R. arctica* is not juvenile, that it shows well-developed and richly branched plants, that the stem- and branch-leaves are well preserved, that the leaves and the cell structure are very different from those of *R. Bolanderi*, and that it would be quite out of the question to consider the two species identical. A comparison of Stephani's figure of *R. arctica* with Pearson's figure of *R. Bolanderi* (12, *pl. 4*, as *R. spicata*) shows that Howe's suggestion is certainly well supported, and a study of Stephani's latest description of *R. arctica* does not bring out any differences which are at all convincing. At the same time the question cannot be regarded as definitely settled until the type specimen of *R. arctica* has been re-examined.

64. **Radula polyclada** sp. nov.

On rocks. Aats Bay (*900* mostly). The accompanying species are *Metzgeria conjugata* and *Frullania nisquallensis*.

Yellowish green, becoming brownish with age, not glossy, growing in loose tufts: stems mostly 2–3 cm. in length and 0.2 mm. in diameter, copiously and regularly pinnate, a branch usually arising behind each stem leaf, the branches widely spreading, 0.12 mm. in diameter, with smaller leaves than the stem, usually limited in growth after reaching a length of 0.5 cm. or less, often simple but sometimes bearing a few scattered and very short branches, 0.5 mm. long and 0.06 mm. in diameter, with still smaller leaves; rhizoids none: stem leaves contiguous to loosely imbricated, the lobe convex and sometimes revolute at the apex, spreading at an angle of about 80 degrees, slightly falcate, broadly ovate, about 1 mm. long and 0.85 mm. wide, attached by an almost longitudinal line, antical margin slightly or not at all dilated at the base, straight or somewhat rounded and arching partially across the axis, very rarely slightly beyond it, strongly outwardly curved to the broad and rounded apex, postical margin somewhat outwardly curved, forming a slight indentation at junction, with the slightly arched and scarcely decurrent keel; lobule subrhombiform in outline, about 0.55 mm. long and 0.4 mm. wide, more or less inflated along keel and in basal portion, otherwise appressed to the lobe, inner margin attached for almost its entire length by a nearly longitudinal line, not dilated, free margin parallel with keel and forming an angle of about 80 degrees with the inner margin, outer margin subparallel with the inner margin, apex rounded; leaf-cells plane, averaging 11 μ along the antical margin, 16 μ in the middle, and 22 μ at the base, the walls

thin but with small trigones having concave sides, cuticle smooth: leaves of primary branches more or less imbricated, the lobe convex, more obliquely spreading than in the stem-leaves, ovate, about 0.45×0.35 mm.; the lobule trapezoidal in outline, the free margin being shorter than the keel, about 0.3×0.2 mm.: leaves of secondary branches still more obliquely spreading, subequally bilobed, the lobes about 0.18×0.1 mm.: inflorescence unknown. (TEXT FIGS. 2, 3.)



FIGS. 2, 3. *Radula polyclada* Evans. FIG. 2. Part of a stem showing seven branches, postical view, × 25. FIG. 3. Cells from the middle of a lobe, × 330. The figures were both drawn from the type specimen.

The numerous branches with their limited growth give the shoots of *R. polyclada* a distinctly plumose appearance, so that they bear a certain resemblance to the secondary shoots found in *Porella* and in the tropical genus *Bryopteris*. They look in fact as if they also might be secondary shoots arising from a prostrate

caudex, and the absence of rhizoids adds to the plausibility of this idea. Unfortunately no signs of such a caudex can be demonstrated in the present material. Neither can the position which the shoots occupy in nature be made out, although they are probably pendulous or ascending.

Among Alaskan species *R. Bolanderi* is apparently the closest ally of *R. polyclada*. It is, however, a somewhat smaller plant, the stems being only 1–2 cm. in length and 0.12 mm. in diameter, while the maximum size of the stem-leaves is about 0.85×0.65 mm. It differs further in its less regular habit; in its more obliquely spreading stem-leaves, the angle formed with the stem being about 60 degrees; in the presence of rhizoids on its lobules; and in the apices of the lobules of its stem-leaves, which are obtuse or subacute instead of being rounded. The leaf-cells are much the same in the two species, both in size and in the characteristics of the cell-walls.

A still closer ally is the recently described *R. prolifera* Arnell,* known only from the type specimen, which was collected in 1898 by H. Nilsson-Ehle at Bulkur, in the valley of the Lena, Siberia. Through the kindness of Dr. Arnell the writer has been enabled to compare a portion of this type specimen with the material of *R. polyclada* and finds that, in spite of their close relationship, the two species cannot be considered synonymous.

In *R. prolifera* the branching is usually just as copious as in *R. polyclada*, and there seems to be an equal lack of rhizoids; the branches, however, are of a somewhat different character. A very small number are essentially like the main stem, their leaves resembling the stem-leaves in all essential respects; but the vast majority are more nearly comparable with the small-leaved secondary branches of *R. polyclada*, except that they are shorter and more often subdivided. They represent the "flagella" of Arnell's description and possibly act as propagula in multiplying the species vegetatively. The stem-leaves of *R. prolifera* differ from those of *R. polyclada* in having a less arched or even straight keel, a scarcely evident indentation at the end of the keel, a more sharply pointed and differently shaped lobule (the outer margin being only about half as long as the inner margin), and sometimes

* Ark. för Botanik 13 : 12. *pl. 1, f. 1, 2.* 1913

a greater dilation at the antical base of the lobe so that the margin arches beyond the stem. The leaves of the flagella are distant and subequally bilobed. So far as measurements go the two species are much the same, the lobes of the stem-leaves in *R. prolifera* measuring about 1×0.85 mm., the lobules about 0.5×0.4 mm., and the lobes of the flagella about 0.2×0.15 mm. In the stem-leaves the cells of the lobes average about 12 μ in diameter along the antical margin, about 18 μ in the middle, and about 20 μ at the base, so that these, too, agree closely with the cell-measurements in *R. polyclada;* and an equally close agreement may be found between the characters derived from the cell-walls.

65. PLEUROZIA PURPUREA (Lightf.) Lindb.

Jungermannia purpurea Lightf. Fl. Scotica 778. 1777.
Jungermannia cochleariformis Hook. Brit. Jung. *pl. 68.* 1814.
Radula cochleariformis Dumort. Syll. Jung. 38. 1831.
Pleurozia cochleariformis Dumort. Recueil d'Obs. sur les Jung. 15. 1835.
Physiotium cochleariforme Nees, Naturg. Europ. Leberm. 3: 79. 1838.
Pleurozia purpurea Lindb. Musc. Scand. 3. 1879.

In very wet places, Brownson Bay (*482*); Metlakatla (*111*); Nichols Bay (*376*). New to America. The species was originally described from specimens collected in Scotland, where it is now known to be widely distributed. It is known also from Ireland, the Faroe Islands, and Norway, and reappears in the Himalyas and in the Hawaiian Islands. Its geographical distribution, therefore, coincides in most respects with that of *Anastrepta orcadensis*, except that its range in Europe is more circumscribed.

The genus *Pleurozia* is one of the most clearly defined genera of the Hepaticae and includes ten species, all of which were known to Jack when he monographed the genus in 1886.* With the exception of *P. purpurea* the species are confined to tropical regions, four being cited by Jack from the Hawaiian Islands. The plants are all of large size, the stems in some of the species attaining a length of 12 cm., and all are characterized by a more or less marked

* Monographie der Lebermoosgattung *Physiotium*. Hedwigia 25: 49–87. *pl. 1–10.* 1886.

purple pigmentation. One of the most remarkable features of the genus is found in the apical cell, which has only two cutting faces instead of three, as in all the other genera of the leafy hepatics. This interesting peculiarity was first pointed out by Goebel,* who naturally associated with it the total lack of underleaves. Even more interesting features, however, are found in the leaves. These, except in a single species, are bilobed and complicate, the postical lobe forming a highly complex water-sac, the mouth of which is closed by a complicated valve. The details of this singular structure are fully described by Goebel, in the place just quoted, so that it is unnecessary to include an account of them here.

The only species with which *P. purpurea* need be especially compared are *P. gigantea* (Web.) Lindb.† and *P. conchaefolia* (Hook. & Wils.) Aust.‡ both of which occur in the Hawaiian Islands, although not confined to them. In all three species the entire postical lobe takes part in the formation of the water-sac. In *P. purpurea*, however, the antical lobe is shortly bilobed at the apex with triangular spinose-dentate lobes, while in *P. gigantea* the antical lobe is usually quite undivided and much less sharply toothed. In *P. conchaefolia* the postical lobe is relatively much larger than in *P. purpurea*, instead of being about half as long, while the antical lobe is truncate or only slightly emarginate and otherwise entire in the apical portion. A full description of *P. purpurea*, with figures, is given by Macvicar,§ and an account of a well-developed perianth with its bracts has recently been published by Schiffner.‖

66. PORELLA NAVICULARIS (Lehm. & Lindenb.) Lindb.

On trees. Brownson Bay (*479*); Kanagunut Island (*41*); Port San Antonio (*Foster 1121*); Ratz Harbor (*296*); Shipley Bay (*768*); Tam Gas Harbor (*135*). Previously reported by Gottsche, Lindenberg, and Nees von Esenbeck (**5**, p. 297, as *Madotheca navicularis*), Stephani (**14**, p. 98, as *M. naviculares*), and the writer (**3**, p. 313).

* Flora **77**: 453. 1893.

† Hep. Scand. Exs. No. 5. 1874 (=*Jungermannia gigantea* Web.).

‡ Bull. Torrey Club **5**: 17. 1874 (= *Jungermannia conchaefolia* Hook. & Wils.).

§ Student's Handb. British Hepat. 394. *f.* 1–3. 1912.

‖ Oesterr. Bot. Zeitschr. **62**: 11. *f.* 1–3. 1912.

67. PORELLA RIVULARIS (Nees) Trevis.

On rocks. Seward (*Rigg 1215, 1229*); Shipley Bay (*765*). Previously reported by Howe (**6**, p. 523; 7, p. 60) and the writer (**3**, p. 312).

68. PORELLA ROELLII Steph.

On trees and logs. Hidden Inlet (*65, 76*). New to Alaska.

69. FRULLANIA FRANCISCANA M. A. Howe

On branches of bushes. Port San Antonio (*614*). Previously reported by the writer (**3**, p. 313).

70. FRULLANIA NISQUALLENSIS Sulliv.

On trees, bushes, and rocks. Aats Bay (*900* in part); Augustine Bay (*583*); Brownson Bay (*471*); Exchange Cove (*277*); Hidden Inlet (*78, 84*); Kanagunut Island (*51*); Metlakatla (*102*); Morse Cove (*455*); Nichols Bay (*374*); Port Alice (*Foster 731*); Port Malmsbury (*989* in part); Ratz Harbor (*294*); Shipley Bay (*772, 776, Foster 780*); Tam Gas Harbor (*115, 127, 132*). Previously reported by Stephani (**14**, p. 98), Coville (**2**), and the writer (**3**, p. 312).

ADDITIONAL HEPATICAE KNOWN FROM ALASKA

As in the preceding list the numbers in parentheses refer to the Bibliography on page 578, and the species are arranged according to Schiffner.

MARCHANTIACEAE. 1. *Sauteria alpina* (Nees & Bisch.) Nees (Howe, **7**, p. 39). 2. *Grimaldia fragrans* (Balb.) Corda (Evans, **3**, p. 290).

METZGERIACEAE. 3. *Riccardia major* Lindb. (Evans, **4**, p. 129, as *Aneura major*). 4. *Metzgeria hamata* Lindb. (Miss Cooley, **1**, p. 247). 5. *Pellia epiphylla* (L.) Corda (Miss Cooley, **1**, p. 247). 6. *P. Fabroniana* Raddi (Evans, **3**, p. 293, as *P. endiviaefolia*). 7. *Blasia pusilla* L. (Evans, **3**, p. 293).

JUNGERMANNIACEAE. 8. *Gymnomitrium concinnatum* (Lightf.) Corda (Stephani, **14**, p. 96). 9. *G. corallioides* Nees (Stephani, **14**, p. 96; Merriam, **9**; Howe, **7**, p. 102). 10. *G. crenulatum* Gottsche (Stephani, **15**, vol. 1, p. 143, as *Acolea crenulata*). 11. *Marsupella sphacelata* (Gieseke) Dumort. (Stephani, **14**, p. 96, as

Sarcoscyphus sphacelatus). 12. *Nardia compressa* (Hook.) S. F. Gray (Evans, 3, p. 290). 13. *N. Geoscyphus* (DeNot.) Lindb. (Evans, as *N. haematosticta*, 3, p. 296; 4, p. 130). 14. *N. obovata* (Nees) Carringt. (Evans, 3, p. 297). 15. *Jungermannia caespiticia* Lindenb. (Evans, 4, p. 130). 16. *J. lanceolata* L. (Evans, 3, p. 299). 17. *J. sphaerocarpa* Hook. (Evans, 3, p. 298). 18. *Anastrophyllum Reichardtii* (Gottsche) Steph. (Evans, 3, p. 299, *pl. 16, f. 4–17*). 19. *Lophozia attenuata* (Lindenb.) Dumort. (Evans, 3, p. 304; 4, p. 131). 20. *L. guttulata* (Lindb. & Arnell) Evans (Evans, 3, p. 302). 21. *L. heterocolpa* (Thed.) M. A. Howe (Evans, 3, p. 304). 22. *L. lycopodioides* (Wallr.) Cogn. (Howe, 8, p. 103). 23. *L. obtusa* (Lindb.) Evans (Evans, 3, p. 303). 24. *L. quadriloba* (Lindb.) Evans (Evans, 3, p. 304). 25. *L. ventricosa* (Dicks.) Dumort. (Stephani, 14, p. 97, as *Jungermannia ventricosa;* Evans, 3, p. 301). 26. *Sphenolobus saxicola* (Schrad.) Steph. (Stephani, 14, p. 97, as *Jungermannia saxicola*). 27. *Temnoma setiforme* (Ehrh.) M. A. Howe (Stephani, 14, p. 97, as *Jungermannia setiformis;* Evans, 3, p. 308, as *Blepharostoma setiforme*). 28. *Anthelia Juratzkana* (Limpr.) Trevis. (Evans, 3, p. 309). 29. *Diplophyllum argenteum* (Tayl.) Spruce (Underwood, 16, p. 366). 30. *D. imbricatum* (M. A. Howe) Steph. (Howe, 8, p. 104, *pl. 14*, as *Scapania imbricata*). 31. *Scapania curta* (Mart.) Dumort. (Evans, 3, p. 312; 4, p. 132). 32. *Radula arctica* Steph. (Stephani, 14, p. 98, *pl. 3, f. 11*). 33. *R. complanata* (L.) Dumort. (Stephani, 14, p. 97, *pl. 3, f. 10*, as *R. Krausei;* Coville, 2, as *R. Krausei;* Evans, 3, p. 312; 4, p. 132). 34. *Porella platyphylla* (L.) Lindb. (Gottsche, Lindenberg, and Nees von Esenbeck, 5, p. 279, as *Madotheca platyphylla;* Stephani, 14, p. 98, as *M. platyphylla;* Miss Cooley, 1, p. 247). 35. *Frullania chilcootiensis* Steph. (Stephani, 14, p. 98).

The following species have likewise been reported from Alaska but on insufficient evidence:

1. *Asterella fragrans* (Schleich.) Trevis. (Howe, 7, p. 39). The record was based on a specimen collected at Telegraph Creek, British Columbia (close to the Alaska boundary), by G. M. Dawson. The species is surely to be expected in Alaska.

2. *A. tenella* (L.) Beauv. (Rothrock, 13, as *Fimbriaria tenella*). A species of eastern North America. Rothrock's specimens, as

already noted by the writer (3, p. 288), have disappeared, so that it is impossible to determine upon which species his record was based.

3. *Chiloscyphus polyanthus* (L.) Corda (Evans, 3, p. 306). The report was based on very fragmentary specimens which, in view of the recent critical work done on the genus *Chiloscyphus*, are hardly in a condition to be determined.

4. *Lepidozia setacea* (Web.) Mitt. (Evans, 3, p. 308). The specimens listed belong to the subgenus *Microlepidozia* but are unfortunately sterile; their reference to a definite species is therefore uncertain.

4. *Frullania Tamarisci* (L.) Dumort. (Gottsche, Lindenberg, and Nees von Esenbeck, 5, p. 439). This species has not been collected recently in the Pacific Coast region. The specimens recorded in the Synopsis Hepaticarum are referred to the variety *laxa*, and possibly belong to *F. nisquallensis*. Unfortunately they have not been accessible to the writer.

DISCUSSION OF THE HEPATIC FLORA OF ALASKA

The general features of the hepatic flora of Alaska have already been pointed out by the writer (3, p. 289). In the northern part of the territory the flora is essentially like that of other northern regions; in the southern and southeastern parts the northern species become mingled with species characteristic of the Pacific Coast region of North America. The predominance of northern elements is apparent from the fact that sixty-nine of the species known from Alaska occur also in northern Europe and Asia, eighteen occur in northern Europe but have not yet been reported from Asia, while one, *Diplophyllum plicatum*, occurs in northern Asia but is unknown in Europe. Of the remaining eighteen species seventeen are Pacific Coast species and one, *Lepidozia sandvicensis*, occurs also in the Hawaiian Islands.

The seventy-one species common to both Europe and Asia are circumpolar in their distribution with the exception of *Metzgeria hamata*, *Anastrepta orcadensis*, and *Pleurozia purpurea*. These three species, although found in northern Europe, are limited in Asia to tropical regions, so far as known at the present time. Although it is hardly advisable to give a complete list of the cir-

cumpolar species, a list of the species which are known from Europe but not from Asia follows. It is needless to state that this list will probably be diminished when the hepatic flora of Asia is more fully known.

Riccardia major
Pallavicinia Flotowiana
Gymnomitrium crenulatum
G. obtusum
Nardia compressa
N. Geoscyphus
N. obovata
Jungermannia caespiticia
Anastrophyllum Reichardtii
Lophozia obtusa
Lophocolea cuspidata
Cephalozia leucantha
Bazzania Pearsoni
Herberta adunca
Diplophyllum ovatum
Scapania nemorosa
S. uliginosa
S. umbrosa

Of the European species occurring in Alaska the following belong to the so-called Atlantic species, being restricted in Europe to the neighborhood of the Atlantic coast:

Metzgeria hamata
Gymnomitrium crenulatum
Bazzania Pearsoni
Herberta adunca
Pleurozia purpurea

The characteristic Pacific coast species occurring in Alaska are listed below. All are endemic to North America and several are known only from Alaska.

Gyrothyra Underwoodiana
Plagiochila alaskana
P. Fryei
Lepidozia filamentosa
Ptilidium californicum
Diplophyllum argenteum
D. imbricatum
Scapania Bolanderi
S. cordifolia
Radula arctica
R. Bolanderi
R. polyclada
Porella navicularis
P. Roellii
Frullania chilcootiensis
F. franciscana
F. nisquallensis

A most surprising feature of the hepatic flora of Alaska is the group of species which are found also in the Hawaiian Islands. Some of these have already been mentioned on the preceding pages, but a complete list, as follows, may be of interest:

Marchantia polymorpha
Riccardia multifida
Anastrepta orcadensis
Lepidozia sandvicensis
Diplophyllum albicans
Pleurozia purpurea

The occurrence of Atlantic species and of Hawaiian species in Alaska is of much interest, although it is impossible to point out at the present time what its significance may be. Such a species as *Pleurozia purpurea*, which is evidently a stable species of great age, may originally have been much more abundant and more evenly distributed than at the present time. Then, through the encroachment of other species at various portions of its range, it may have become restricted to the isolated regions where it is now found. This might explain the occurrence of the species in both western Europe and Alaska and its absence from the intervening regions. There is little evidence, however, that the volcanic Hawaiian Islands were ever connected with either North America or with the mainland of Asia, so that it is difficult to account for any close connection between the plants of the Islands and those of Alaska or the Himalyas.

The most remarkable species in the present collection came from southeastern Alaska, and it is probable that many other Hepaticae remain to be discovered in this interesting region. Such a species as *Scapania planifolia* (Hook.) Dumort., for example, which often grows in company with *Pleurozia purpurea* in western Europe ought surely to be expected, especially since it occurs also in the Himalyas and in the Hawaiian Islands. And, in view of the presence of the very rare *Bazzania Pearsoni* in Alaska, other Atlantic species of circumscribed range may come to light. In any case southeastern Alaska is recommended to collectors as an unusually favorable region for careful study.

SHEFFIELD SCIENTIFIC SCHOOL,
YALE UNIVERSITY

Explanation of plate 21

Plagiochila alaskana Evans. 1. Part of a stem with perianth, antical view, ×23. 2. Part of a stem with perianth, lateral view, ×23. 3. Leaf spread out, ×23. 4. Bract spread out, ×23. 5. Cells from the middle of a leaf, ×300. 6. Marginal tooth of a leaf, ×300. The figures were all drawn from the type specimen.

Plagiochila Fryei Evans. 7, 8. Leaves spread out, ×23. 9. Cells from the middle of a leaf, ×300. The figures were all drawn from the type specimen.

Branched cells in the prothallium of Onoclea sensibilis L.

CAROLINE A. BLACK

(WITH PLATES 22 AND 23)

The fern gametophyte offers an interesting field for experimental culture work, not only in regard to the reproductive organs as various writers have shown, but in the germination of the spore and the development of the prothallium. Material is readily procured and the growing conditions may be easily controlled. The average fern spore will germinate on water or moist soil and the prothallium lives about three or four months or until a sporophyte has been established. Many have been known to live much longer.

The normal development of the gametophyte of different ferns has been described by various writers. In a recent research on the prothallium of *Camptosorus rhizophyllus* (L.) Link, Pickett (1) found that the prothallia showed a wide variation in size and form. The apical group is usually unsymmetrically placed and the typical wedge shaped apical cell is rarely seen. Old prothallia were found with several marginal growing regions and proliferations capable of independent growth were produced. In some very interesting experiments with this fern Pickett (2) had already shown that the drought resisting character of these prothallia was an efficient factor in the establishing of this fern to its habitat.

The dioecious prothallia of *Onoclea Struthiopteris* (L.) Hoffm. have been the subject of a physiological problem by Miss Wuist, (3) who has obtained monoecious forms in this fern by growing prothallia in culture solutions. Monoecious prothallia were also observed in soil cultures. Miss Wuist mentions the appearance of irregular and filamentous forms, some exceedingly long, in these cultures. Mottier (4) working with the same fern finds that about 12 per cent. of the prothallia are monoecious under optimum culture conditions. Branched filamentous prothallia have been described by Miss Pace (5) in fern gametophytes. Many examples

of the retention of the filamentous form of gametophyte due to feeble light and poor nutritive conditions and even of a reversion to the formation of cell threads, after an expanded prothallium had been established when nutritive conditions became unfavorable are given in Goebel's Organography (**6**, pp. 202–205).

Some very irregular filamentous prothallia, evidently the result of feeble light and poor nutritive conditions, were found by the writer in an old culture of *Onoclea sensibilis* L. A rather unusual character of these prothallia was the tendency of certain cells to branch. It was thought that a description of them might be of interest to others investigating fern prothallia.

Spores of *Onoclea sensibilis* were sown upon sterile distilled water for class use. Through oversight, the covered glass dish containing the culture was left undisturbed in somewhat dim light for approximately six weeks. When it was then observed the culture appeared green and healthy. Upon examining the culture, part of the prothallia were floating on the surface of the water and some smaller clumps were entirely submerged near the bottom of the dish. Slides were prepared from both sources. The prothallia taken from the surface presented the typical form with a well-defined apical region as shown in FIG. 1. Some of them consisted of thirty to fifty cells and bore a few antheridia.

The submerged prothallia were found to differ considerably from the normal gametophyte. In these prothallia the cells were greatly elongated and contained few chloroplasts scattered throughout. It was of interest to note that many cells had produced one or more outgrowths without cutting off the usual cross wall. FIG. 2 shows a five-celled prothallium, the last two cells of which are unusually long. The enlarged end of the apical cell is turned, indicating an abrupt change in the direction of growth. In FIG. 3 a small cell arises from the elongated apical cell. This cell is so turned that it is growing in the opposite direction from the main apical cell. This cells resembles a rhizoid except for its size and the presence of chlorophyll. In FIG. 4, the end of the filament forms an acute angle with the main cell-thread. This is due to a change in the direction of growth of the apical cell. A very small outgrowth is cut off laterally from the apical cell. The abrupt turning of the branches is not caused by contact with

the wall of the glass dish as none of the submerged prothallia examined were observed near the side of the dish. Fig. 5 seems a more normal prothallium having average sized cells. The end of the filament is turned so that there is a possibility of two growing regions here.

An extreme case of the tendency to form branched cells is seen in FIG. 6. Two cells of this filament have well defined protuberances, one of which is considerably elongated. The tip of the apical cell is also somewhat curved. A two-armed prothallium is seen in FIG. 7, due to the branching of one cell. This is an unusually long filamentous prothallium. The shorter branch consists of two cells. FIGS. 8 and 9 show great variety in the apical cell, each having a number of lobes. This suggests considerable diversity in the subsequent growth of the prothallium. In each case the apical cell is curved with two lobes at the extreme tip. FIG. 10 shows a young stage of a two-armed prothallium. In FIG. 11, three branches are found with their origin in one cell. Two of these branches are limited by cross walls. The increased activity of the cells where one or more branches are produced may be explained by considering that the active cell was once the apical cell and in a normal prothallium would remain the center of growth.

In sowing fern spores it is not unusual to find sporangia or a fragment of leaf in the culture. It was thought that an attached sporangium or bit of leaf caused the sinking of some of the spores, thus changing their environment by completely surrounding the developing prothallia with water. The dish was covered with a loosely fitting lid so that prothallia growing on the surface of the water would receive a sufficient supply of oxygen. The amount of oxygen would necessarily be limited in the prothallia growing below the surface of the water. It is suggestive that the oxygen requirement may have been a factor in producing these irregular gametophytes.

Besides the filament of elongated cells characteristic of impoverished prothallia, the accompanying drawings show that these prothallia differ from the normal gametophyte in one or more of the following characteristics:

1. A change in the direction of growth of the filament may occur by the apical cell forming an acute angle with the main cell thread (FIG. 4).

2. The production of an irregularly lobed apical cell (FIGS. 2, 8, 9).

3. An individual cell in the filament may develop an outgrowth or branch without forming a cross wall at the base (FIGS. 6, 7, 10).

4. A branched filamentous prothallium may have the proliferations originating in one cell (FIGS. 7, 10, 11).

5. An increase in the number of growing regions. (FIGS. 3–11).

An exact knowledge of the optimum physiological conditions under which fern prothallia will grow and the changes that occur when this condition is modified would be of interest since the fern gametophyte has shown itself to possess great potentiality.

NEW HAMPSHIRE COLLEGE,
DURHAM, NEW HAMPSHIRE

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Explanation of plates 22 and 23

All the figures were drawn with the aid of a camera lucida.

FIG. 1. Normal prothallium from the surface of culture showing typical form with a well-defined apical region.

FIG. 2. A five-celled prothallium with an unusually long apical cell, swollen at the end, which is turned, indicating an abrupt change in the direction of growth.

FIG. 3. The end of the filament forms an acute angle with the main cell thread.

FIG. 4. A small cell cut off from the apical cell is growing in the opposite direction.

FIG. 5. A normal gametophyte with the possibility of two growing points.

FIG. 6. An extreme case of branched cells; two cells have well-defined protuberances.

FIG. 7. Two filaments originating in a two-armed cell.

FIGS. 8, 9. Irregularly lobed apical cells.

FIG. 10. A two-armed prothallium due to the branching of one cell.

FIG. 11. Three branches originating in one cell.

The correct name for the hemlock spruce*

OLIVER A. FARWELL

A casual perusal of the local floras covering eastern North America shows that the white spruce passes under the name of *Picea canadensis* (Mill.) BSP. and the hemlock spruce, of *Tsuga canadensis* (L.) Carr. Now, although Britton, Stearns, and Poggenberg quote Miller as the original author of the specific name *canadensis* of the white spruce, it becomes very evident through a perusal of Miller's description that his specific name is derived from the Linnaean *Pinus canadensis* and, therefore, that the proper citation (under article 41 of the Vienna rules) should include the name of Linnaeus, in parentheses, as the original author, instead of that of Miller. Here is, then, the anomalous position of two distinct species bearing the same specific name and both being derived from the same author, publication, and description, a condition contrary to all laws of botanical nomenclature, which provide that the specific name can be maintained for only one element of an aggregate when that aggregate is segregated. It remains, therefore, to determine which one of these two species shall retain the specific name *canadensis*. The first step is to determine if possible, what the Linnaean type of *Pinus canadensis* may be; if that can be determined, the rest will be easy, for the type element of an aggregate will retain the specific name upon segregation.

The description of *Pinus canadensis* in the 2d edition of the Species Plantarum, 1763, on page 1421, is as follows:—

10. PINUS foliis solitariis linearibus obtusiusculis *canadensis* submembranaceis.

Abies foliis solitariis confertis obtusis membranaceis. *Gron. virg.* 191.*

Abies foliis piceae brevioribus, conis parvis biuncialibus laxis. *Mill. dict. t.* 1.

Habitat in America *septentrionali.* ♄.

* Contributions to the Botany of Michigan, No. 10. Read at the St. Louis meeting of the Botanists of the Central States, October 17, 1914.

As there is no specific mention of a type we may arrive at one by considering (1) the herbarium specimens, (2) the description, (3) the synonyms, and (4) the specific name and habitat. *Pinus canadensis* is represented in the Linnaean Herbarium, but Mr. B. D. Jackson, in his Index to the Linnaean Herbarium, shows that the specimen was not received until later than 1767, several years after the publication of the species, and that it is not authenticated by Linnaeus; it may therefore be disregarded as not bearing upon the point in question.

The descriptive phrase of Linnaeus is not distinctive and can not limit his species to any one form; he took no consideration of the cones whatever; he described the leaves as solitary, linear, somewhat obtuse, and submembranaceous, characters that apply to the leaves of a number of species of the solitary-leaved Abieteae and therefore can not be considered as specific in character. The first synonym cited is that of Gronovius. Gronovius' species was published as follows on page 191 of the 1st edition of the Flora Virginica, part 2, 1743:

ABIES *foliis solitariis confertis obtusus membranaceis.*

Abies minor pectinatis foliis Virginiana conis parvis, subrotundis. *Plukn. Alm. p. 2 t.* 121 *Fig.* 1

Abies minor Taxifoliis, conis parvis subrotundis, deorsum spectantibus. *Clayton N.* 547

Folia linearis, plana, tenuissima, carinata, obtusa, confertim natam solitaria. Coni magnitudine fragae, ovati, acuminati, squamis numerosis planis subrotundis obtusissimis.

In this connection it may properly be remarked that the plant of Plukenet, which is presumably the type of his figure 1, plate 121, is preserved in the Herb. Sloane, volume 95, folio 1, and is the hemlock spruce, generally known as *Tsuga canadensis* Carr.; also that the plant of Clayton, No. 547, upon which Gronovius based his species, is preserved at the British Museum and is the same thing.

Here we have not only a very accurate description of the leaves and cones but herbarium specimens and a published figure to supplement the descriptions, all of which, taken together, accurately limit the species defined to the hemlock spruce commonly known as *Tsuga canadensis* Carr. Apparently this should be

definite enough to fix the status of *Pinus canadensis* L. But let us go a little deeper into the question before taking up the next synonym. *If we take the first synonym enumerated under a species as the type of that species, in case no type is specifically named,* then *Pinus canadensis* L. becomes a pure synonym of *Pinus balsamea* L., for the first synonym cited under both species is the same Gronovian species, which is the hemlock spruce! Let us, therefore, investigate the *Pinus balsamea* of Linnaeus, published on page 1002 of the 1st edition of the Species Plantarum in 1753, as follows:

Balsamea. 9. PINUS foliis solitariis subemarginatis: subtus linea duplici punctata.

Abies foliis solitariis confertis obtusis membranaceis. *Gron. virg.* 191.*

Abies minor, pectinatis foliis, virginiana, conis parvis subrotundis. *Pluk. alm.* 2. *t.* 121. *f.* 1. *Raj. dendr.* 8.

Habitat in Virginia, Canada. ♃

Habitus antecedentis [*Pinus Picea*], *sed* Folia *latiora, obtusiora, utrinque per ramos pectinatim digesta, at duplici serie, superiore sc. breviore, subtus sunt picta linea duplici glauca: singula ex 8 ordinibus longitudinalibus punctorum alborum.* Apex *foliorum saepe bifidus.*

A careful inspection of the above shows that it is an aggregate and composed of such divergent species as the balsam firs with *erect* cones and the hemlock spruce with *hanging* cones. To which element, then, under the rules of botanical nomenclature, does the name *Pinus balsamea* L. belong? There is unfortunately no rule covering this point in the Vienna rules nor, so far as the writer is aware, in any other code. There are no generic descriptions in the Species Plantarum and while there are specific diagnoses, these, from the modern point of view, are drawn so loosely in many cases that they are of little diagnostic value. Furthermore, the Species Plantarum is not considered to be a descriptive work but a mere application of the binomial system to the then known species—those that already had been published under the polynomial system by various older authors—and the species therein

enumerated are considered to be based upon citations rather than upon the descriptive phrases. Should then the most emphasis be placed upon the description or upon the citations? This is an important principle upon which no agreement has been reached; it ought to be definitely settled by a botanical congress, since very often, as in the present instance, widely different results may be obtained by different authors following out the different methods of treatment. Some authors prefer to adopt the descriptive matter as their guide, others the synonyms cited; so that we have such expressions as *Sonchus alpinus* L., as to character; or, as to the synonymy; or, as to the habitat, as the case may be. In the present instance, and it might be said in all instances of the kind, the best way is to let the internal evidence decide, adopting the name for that element which receives the preponderant weight of evidence. *If citations are considered to carry the greatest weight,* for the Species Plantarum is *par excellence* the work in which the binomial system is applied to citations, *then the name Pinus balsamea* L. *belongs to the hemlock spruce, for all the citations under that name are of this species.* The Linnaean herbarium contains no specimen which can be designated as the type, since it contained no specimen of the species at the time of its publication. Let us now look at the descriptive matter—the diagnostic phrase and the note under *Habitus*. There is absolutely nothing in the descriptive matter that will limit it to any one species; the cones are not at all considered; the characters ascribed to the leaves are applicable to other species than the balsam fir; in other words they are of a group or groups of a higher order than that of a species, i. e., an aggregate. The same may be said of the habitat given, which is Virginia and Canada; the specific name is *balsamea*, and this alone is indicative of what Linnaeus may have had in view as the type of his species. As a matter of fact, the *Pinus balsamea* of Linnaeus is so broadly drawn that it may be appropriately considered a huge pit into which *all* the *spruces* and *firs* of eastern North America may be conveniently dropped to form a conglomerate whole. Notwithstanding the fact that the Species Plantarum is primarily a publication founded upon the work of earlier botanists and that the binomials therein are mostly based upon and applied to the citations enumerated from those earlier

botanists, we may be justified, in the present instance, in following precedent and in disregarding the synonyms cited and the description also, allowing the name to represent the balsam fir; for this is undoubtedly the interpretation Linnaeus intended it to have as is indicated by the specific name.

Having excluded the hemlock synonyms from consideration under *Pinus balsamea* and having settled the status of that species we may resume consideration of *Pinus canadensis*. We have already shown that the first citation refers definitely to the hemlock spruce. We will now consider the Millerian synonym and endeavor to determine its status. This carries us back to the 7th edition of the "Gardeners Dictionary" published in 1759 and the "Figures" published in 1760. In the former work, Philip Miller has segregated the Linnaean aggregate and described four species from America under *Abies* as follows:

3. ABIES *minor, pectinatis foliis, Virginiana, conis parvis subrotundis. Pluk. Alm.* The *Virginian* Fir Tree, with small roundish Cones, *commonly called* Hemlock Fir.
4. ABIES *piceae foliis brevibus, conis minimus. Rand.* The Pitch-leaved Fir Tree, with small Cones, *commonly called* The *Newfoundland* Black Spruce Fir.
5. ABIES *piceae foliis brevioribus, conis parvis biuncialibus laxis. Rand.* The shortest Pitch-leaved Fir Tree with loose Cones, *commonly called* The *Newfoundland* White Spruce Fir.
6. ABIES *taxi foliis, odora, Balsami Gileadensis, Raii Hist. App.* The Balm of *Gilead* Fir.

Here we have, so far as the writer is aware, the first post-Linnaean description of the species as they are understood at the present time. Unfortunately, Miller had not at that time accepted the binomial nomenclature of Linnaeus and consequently his species received no specific appellations; his work, however, can not be ignored any more than can the Species Plantarum itself. The descriptions and the notes on the following page as to the native habitats, habits, etc., and the culture of the various plants in England leave no doubt whatever as to the identity of the species. No. 5 was illustrated in the following year, 1760, in the "Figures," and this is the species cited by Linnaeus under

his *Pinus canadensis*. I have not seen the plate published by Miller but, considering the fact that he had a very clear conception of the various species and access to living material of all, I doubt not but that it is characteristic of the white spruce.* We have no choice but to consider the 7th edition of the Gardeners Dictionary to be the publication in which the delimitation or segregation of our spruces and firs began and to be guided accordingly. It has become very clear from the foregoing that the *Pinus canadensis* of Linnaeus is an aggregate consisting of the hemlock spruce and the white spruce. The habitat gives us no clue as to which may be considered the type but the specific name, as in the case of *Pinus balsamea*, may. The white spruce is most characteristically a Canadian species, while the hemlock spruce is characteristically American, using the latter term as equivalent to the United States; hence the specific name indicates the white spruce. Also what more than likely that Linnaeus in establishing his *Pinus canadensis* was guided more by the *recently published but specifically unnamed* plate of Miller, than by the old description of Gronovius? We must also consider the fact that the *Plukenetian species, also illustrated and the true hemlock spruce, was left under Pinus balsamea*. The very fact that the hemlock spruce was divided between the two species is paramount in itself to proof positive that the author did not consider it the type of either. A careful weighing and consideration of the above problems leads to the conclusion that the Millerian synonym, *not the Gronovian*, is the type of *Pinus canadensis* L.

To sum up: *Pinus balsamea* L. of the 1st edition of the Species Plantarum is an aggregate which may be considered to include *all* of the firs, spruces, and hemlocks.

Miller, in 1759, segregated the Linnaean aggregate, recognizing four species, but did not name them under the binomial system.

Linnaeus, in 1763, recognized, in part, the work of Miller and established *Pinus canadensis*, on, we shall claim, the Millerian species (No. 5) but probably intended it to contain all species with *drooping* cones. Unfortunately he neglected to remove the

* Since writing the above I have received a communication from Mr. A. Gepp, of the British Museum, in which he informs me that the plate of Miller referred to is considered by Mr. A. Bruce Jackson, an authority on the Coniferae, to be the *Picea canadensis* BSP., thus confirming the deductions above drawn.

Plukenetian synonym from *Pinus balsamea* which, very likely, was intended to include all species with *erect* cones. Five years afterward, 1768, Miller published the 8th edition of the Gardeners Dictionary and in this work he not only recognized the four species of the 7th edition, but the binomial system also and consequently gave specific appellations to the species.

The balm of Gilead fir or balsam fir (species No. 6 of the 7th edition) becomes *Abies balsamea*, species No. 3.

The white spruce fir (species No. 5 of the 7th edition) becomes *Abies canadensis*, species No. 4.

The black spruce fir (species No. 4 of the 7th edition) becomes *Abies mariana*, species No. 5.

The hemlock fir (species No. 3 of the 7th edition) becomes *Abies americana*, species No. 6.

Nos. 4 and 6 are described as follows:

4. ABIES (*Canadensis*) foliis linearibus obtusiusculis submembranaceis. *The Newfoundland White Spruce Fir.*

Abies foliis piceae brevioribus, conis parvis biuncialibus laxis. Rand.

6. ABIES (*Americana*) foliis linearibus obtusiusculis bifariam versis conis subrotundis. *The Hemlock Spruce Fir.*

A careful comparison of the descriptions of *Abies canadensis* Mill. and *Pinus canadensis* L. shows them to be identical in everything except the Gronovian synonym which Miller has removed from the Linnaean species and described and named as *Abies americana*. Under the Vienna Code, Articles 46 and 47 govern; the latter provides that in segregating a species, the specific name is retained for the element first published; and the former provides that where two or more groups are of the same date the author chooses and his choice cannot subsequently be modified. The conclusions we have arrived at from the above study are:

(1) Linnaeus published *Pinus balsamea* in 1753 and made it broad enough to include all east North American Abieteae with single leaves.

(2) Miller, in 1759, segregated the Linnaean aggregate, recognizing four species.

(3) Linnaeus, in 1763, retained *Pinus balsamea* and described *Pinus canadensis* (dividing the hemlock spruce and placing a part

under each so that it can not be considered typical of either), thus recognizing only two of Miller's four species from America.

(4) Miller, in 1768, reëstablished his four species, and gave them specific appellations under the binomial system as follows: the balsam fir or balm of Gilead fir became *Abies balsamea;* the white spruce, *Abies canadensis;* the black spruce, *Abies mariana;* and the hemlock spruce, *Abies americana.*

Under Articles 46, 47, 48, 50, and 51 of the Vienna Rules this choice of specific names by Miller for these plants can not be modified and the proper names and leading synonyms of the species are as follows:

ABIES BALSAMEA (L.) Mill. Gard. Dict. Ed. 8, No. 3. 1768.

Abies taxifoliis, odora, Balsami Gileadensis, Raii Hist. App. Mill. Gard. Dict. Ed. 7, No. 6. 1759.

Pinus balsamea L. Sp. Pl. Ed. 1, 1002. 1753; Ed. 2, 1421. 1763 (as to name only).

Picea balsamea Loudon, Arb. Brit. 4: 2339. *f. 2240–2242.* 1844.

PICEA CANADENSIS (L.) BSP. Prel. Cat. N.Y. 71. 1888.

Abies piceae foliis brevioribus, conis parvis biuncialibus laxis. Rand. Mill. Gard. Dict. Ed. 7, No. 5. 1759; Figures, *pl. 1.* 1760.

Pinus canadensis L. Sp. Pl. Ed. 2, 1421. 1763 (as to synonym of Miller).

Abies canadensis Mill. Gard. Dict. Ed. 8, No. 4. 1768.

Pinus alba Ait. Hort. Kew. 3: 371. 1789.

Abies alba Michx. Flor. Bor. Amer. 2: 207. 1803 (not of Miller, 1768).

Picea alba Link, Linnaea 15: 519. 1841.

PICEA MARIANA (Mill.) BSP. Prel. Cat. N.Y. 71. 1888.

Abies piceae foliis brevibus, conis minimis. Rand. Mill. Gard. Dict. Ed. 7, No. 4. 1759.

Abies mariana Mill. Gard. Dict. Ed. 8, No. 5. 1768.

Pinus mariana Du Roi, Obs. Bot. 38. 1771.

Pinus nigra Ait. Hort. Kew. 3: 370. 1789.

Abies nigra Du Roi, Handb. Baumg. 2: 182. 1800.

Picea nigra Link, Linnaea 15: 520. 1841.

Tsuga americana (Mill.) nov. comb.

Pinus balsamea L. Sp. Pl. Ed. 1, 1002. 1753; Ed. 2, 1421. 1763 (as to synonyms).

Abies minor, pectinatis foliis, Virginiana, conis parvis subrotundis, Pluk. Alm. Mill. Gard. Dict. Ed. 7, No. 3. 1759.

Pinus canadensis L. Sp. Pl. Ed. 2, 1421. 1763 (as to synonym of Gronovius).

Abies americana Mill. Gard. Dict. Ed. 8, No. 6. 1768.

Pinus americana Du Roi, Obs. Bot. 39. 1771.

Abies canadensis Michx. Fl. Bor. Am. **2**: 206. 1803 (not of Miller, 1768).

Picea canadensis Link, Linnaea **15**: 524. 1841.

Tsuga canadensis Carr. Trait. Conif. 189. 1855.

I wish here to thank Mr. A. Gepp, of the British Museum (Natural History), and Miss Mary A. Day, of the Gray Herbarium, most heartily for many valuable notes and kind assistance.

BOTANICAL LABORATORY,
PARKE, DAVIS & COMPANY,
DETROIT, MICHIGAN

INDEX TO AMERICAN BOTANICAL LITERATURE

1910–1914

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Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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INDEX TO VOLUME 41

New names and the final members of new combinations are in **bold face type.**

Abies, 625; alba, 628; americana, 627, 628, 629; balsamea, 627, 628; canadensis, 627, 628, 629; mariana, 627, 628; nigra, 628

Abrus precatorius, 107

Abutilon Lemmoni, 303

Acacia Berteriana, 8; lentiscifolia, 8; sufirutescens, 303

Acaena, 323, 324; agrimonioides, 323, 324; californica, 324, 325; elongata, 323, 324; elongata gracilis, 324; elongata robusta, 324; laevigata, 323, 324; lappacea, 323, 324; pinnatifida, 324; torilicarpa, 324; tridactyla, 324; trifida, 324

Acalypha alopecuroidea, 12

Acanthospermum hispidum, 13

Acer floridanum, 214, 219; rubrum, 559; saccharum, 512

Acetabula, 158

Achillea borealis, 102; lanulosa, 100; Millefolium, 355, 358, 512, 514, 516, 517, 519, 520; multiflora, 102; subalpina, 100, 471

Achroanthes unifolia, 29, 32, 35

Acolea crenulata, 612

Acomastylis, 490, 491, 494; depressa, 494; gracilipes, 494, 495; humilis, 494; Rossii, 100, 494; sericea, 100, 469, 471, 494, 495; turbinata, 100, 463, 469, 470, 495

Adenostoma, 330, 331; brevifolium, 330; fasciculatum, 330; fasciculatum densifolium, 330; fasciculatum hirsutum, 330; fasciculatum obtusifolium, 330; sparsifolium, 331

Adiantum Capillus-veneris, 44, 308; **rimicola,** 308

Aesculus octandra, 29, 34, 38; Pavia, 214

Aethusa Cynapium, 84

Afzelia cassioides, 561; macrophylla, 29, 35, 45; pectinata, 212

Agaricus, 179; campestris, 111

Agrimonia, 325; Bicknellii, 328; Brittoniana, 329; Eupatoria, 325, 326, 328; Eupatoria glabra, 326; Eupatoria hirsuta, 326; Eupatoria mollis, 327; Eupatoria parviflora, 329; gryposepala, 326; incisa, 329, 330; macrocarpa, 326; microcarpa, 327, 329; mollis, 327; parviflora, 326, 329, 330; platycarpa, 327, 329; polyphylla, 329; Pringlei, 327, 329; pubescens, 327, 328; pumila, 327; rostellata, 326, 328, 329; serrifolia, 329; striata, 325, 327, 328, 329; suaveolens, 329

Agropyron andinum, 99, 463, 464; biflorum, 96, 99, 469; caninum, 96, 469; latiglume, 99, 463, 464; repens, 514, 516, 518; Scribneri, 101, 463

Agrostis, 359, 362; alba, 359, 360, 512, 514, 515, 516, 518; hyemalis, 470; perennans, 308

Akebia quinata, 367

Alaska, Observations on the edge of the forest in the Kodiak region of, 381; Report on the Hepaticae of, 577

Alchemilla, 319, 320; achilleaefolia, 322; alpina, 319; domingensis, 321; filicaulis, 320; glomerulans, 320; hirsuta campestris, 321; nivalis, 321; orbiculata, 320; pectinata, 320; pinnata, 321, 322; pratensis, 320; sibbaldiaefolia, 321; speciosa, 222; vulgaris, 320; Wichurae, 320

Algites americana, 297

ALLARD, H. A., A review of investigations of the mosaic disease of tobacco, together with a bibliography of the more important contributions, 435

Allium, 358; canadense, 358; cernuum, 356, 358

Allocarya hispidula, 341

Alnus rubra, 580; rugosa, 560; sinuata, 472, 473; tenuifolia, 338, 340

Aloe ferox, 126

Alopecurus aristulatus, 470, 471

Alsine americana, 99, 465, 466; baicalensis, 467; dichotoma, 99; laeta, 97, 99, 467, 470; longipes, 97; polygonoides, 99, 468, 469

Alsinopsis obtusiloba, 462, 463; propinqua, 95, 467; quadrivalvis, 96, 468, 469; Rossii, 96, 468, 469; verna, 95, 96

Althea officinalis, 127

Amaranthus, New or notable species of, 505

Amaranthus, 505, 507, 508, 509; acutilobus, 509; blitoides, 512, 517; bracteosus, 508; crassipes, 509; emarginatus, 509; graecizans, 512; Greggii, 507; hybridus, 509; **myrianthus,** 506;

Palmeri, 506; pubescens, 508; retroflexus, 505, 510, 514, 516; Torreyi, 507; Torreyi suffruticosus, 505, 506; viscidulus, 508, 509; **Watsoni,** 505
Amarella Amarella, 96; arctophila, 102; monantha, 96; plebeja, 96, 470; propinqua, 102; scopulina, 472; strictiflora, 470, 472; tenella, 96
Ambrosia artemisiifolia, 357, 360, 512, 514; psilostachya, 512
Amelanchier Cusickii, 341; florida, 340; sp. 214
Amomum Melegueta, 107, 127
Amorpha canescens, 355, 356
Ananas sativa, 153
Anastrepta, 588, 589; orcadensis, 588, 589, 601, 610, 614, 615
Anastrophyllum Reichardtii, 613, 615
Anastrophus compressus, 560
Anchistea virginica, 560
Ancistrum, 323
Andromeda Cooki, 298; grandifolia, 298; novae-caesareae, 298; Parlatorii, 298
Andropogon furcatus, 354, 355, 357, 363; scoparius, 354, 357; virginicus, 28, 33, 35
Androsace albertina, 96; carinata, 96, 462, 464; Chamaejasme, 96; septentrionalis, 102; subumbellata, 470
Anemiopsis, 232
Anemone, 490; canadensis, 29, 35; globosa, 101; narcissiflora, 96; parviflora, 94; tetonensis, 101; zephyra, 96, 470
Anethum graveolens, 84
Aneura major, 612
Angelica atropurpurea, 107; Grayi, 101, 470; Roseana, 471
Anisacanthus Thurberi, 303
Anneslia **colletioides,** 18; **enervis,** 18
Antennaria alpina, 97, 102; aprica, 463; media, 97, 463; monocephala, 102; nardina, 472; plantaginifolia, 356, 357; rosea, 339; sedoides, 465; umbrinella, 97
Anthelia julacea, 601; Juratzkana, 613
Anthemis Cotula, 514, 516; nobilis, 126
Anthonomus grandis Thurberiae, 301
Anthropogon barbellatum, 99, 468; ciliatum, 99
Anticlea coloradensis, 466
Antiphylla oppositifolia, 466
Antrophyum minimum, 398; Wercklеanum, 398
Aphanes, 319, 320, 321; arvensis, 320; australis, 320; cuneifolia, 320; macrosepala, 320; occidentalis, 320
Aphyllon, 231
Apium graveolens, 107, 127; Petroselinum, 107, 127
Apocynum androsaemifolium, 109, 340; cannabinum, 109, 359
Appearance of polar bodies in the spermogenous tissue of Ricciocarpus natans (L.) Corda, The, 333
Aquilegia brevistyla, 100; coerulea, 467; flavescens, 470; Jonesii, 464; saximontana, 100, 465, 466
Aragallus deflexus, 100, 470; foliolosus, 100; Hallii, 464; podocarpus, 97, 464
Aralia groenlandica, 298; nudicaulis, 83; racemosa, 222; Ravniana, 298; spinosa, 28, 32, 35, 41, 42, 44, 46, 214, 560; Washingtoniana, 296
Araliaceae, 83
Araliopsis, 296, 297; breviloba, 296; cretacea, 296; cretacea dentata, 296; cretacea salisburiaefolia, 297
Araucaria bladenensis, 297; marylandica, 297
Archangelica officinalis, 126
Arctium Lappa, 121; minus, 514
Arctostaphylos Uva-ursi, 415
Arctuos, 472
Arenaria Fendleri, 464; serpyllifolia, 514, 515, 520; Tweedyi, 464
Aristida dichotoma, 29, 36; stricta, 561, 563
Aristolochia reticulata, 107; Serpentaria, 107, 127
Arnica cordifolia, 339; montana, 107, 126; Parryi, 471
Aronia nigra, 29, 35, 421
Artemisia, 110; arctica, 102; borealis, 96; ludoviciana, 338, 340, 512; norvegica, 96; Parryi, 101, 468; Pattersonii, 101, 468; pauciflora, 107; Richardsoniana, 102; saxatilis, 468; saxicola, 96; scopulorum, 101, 467; spithamaea, 96, 468, 469
Aruncus Aruncus, 28, 33, 35
Asarum arifolium, 214, 216
Asclepias, 109; incarnata, 358; linearis, 303; mexicana, 340; Sullivantii, 29, 32, 36, 38, 356, 358; syriaca, 358; tuberosa, 109, 355, 356; variegata, 29, 32, 34, 38; verticillata, 355, 360
Ascobolus, 161, 172, 179, 183, 195, 196; carbonarius, 159, 160, 162, 163, 164, 166, 172, 187, 192, 193, 194, 197; furfuraceus, 159, 160, 161, 179, 180, 181, 183, 184, 186, 187, 188, 189, 193, 194, 195; glaber, 160, 193; immersus, 186, 190, 194; Leveillei, 189, 190, 194; magnificus, 181, 183, 185, 186, 192, 193, 196, 197; mirabilis, 162, 166; pusillus, 193; Winteri, 186, 189, 194
Ascodesmis, 161, 181, 190, 192, 193; nigricans, 159, 184
Ascophanus carneus, 159, 160, 172, 193; pilosus, 159
Ascyron hypericoides, 28; multicaule, 33, 35

Asimina parviflora, 212
Aspergillus, 169, 171, 182, 193; flavus, 289; herbariorum, 159, 161; niger, 290; repens, 159
Asperula, 225
Aspidiophyllum, 296, 297; trilobatum, 297
Asplenium cecilensis, 297; Dicksonianum, 296; montanum, 29, 32, 36; pinnatifidum, 28, 33, 36
Aster, 13; adnatus, 13, 14; alpinus, 94, 471; apricus, 470; **bahamensis,** 13, 14; Bracei, 13 15; **Burgessii,** 13, 14; carneus, 15; divaricatus, 28, 33, 35; Douglasi, 338; dumosus, 13, 15; expansus, 15; exilis, 13, 15; foliaceus frondosus, 338; **Grisebachii,** 13, 14; inconspicuus, 13, 15; laevis Geyeri, 338, 340; lucayanus, 13, 14; macrophyllus, 29, 35; marginatus, 14; multiflorus, 354, 360; Novae-Angliae, 357; oreganus, 339, 340; panniculatus, 359; sericeus, 354; squamatus, 13, 15; Trifolium, 15; tripolium, 15
Asterella fragrans, 613; tenella, 613
Astragalus alpinus, 93; Purshii, 340; villosus, 212
Atelophragma elegans, 470
Atlantic coastal plain, Contributions to the Mesozoic flora of the, X—Maryland, 295
Atriplex angustifolia, 303
Atropa Belladonna, 107, 125
ATWELL, R. S. The appearance of polar bodies in the spermogenous tissue of Ricciocarpus natans (L.) Corda, 333
Avena, 225; americana, 100; Mortoniana, 100, 464; sativa, 516, 520
Avicennia, 231
Azalea glauca, 413; hispida, 413; lutea, 29, 30, 32, 35; nitida, 413; viscosa, 413

Bacillus mycoides, 290; prodigiosus, 290; pyocyaneus, 290; subtilis, 290; Tetani, 267
Baeomyces roseus, 159
BAILEY, V. Wild cotton plant (Thurberia thespesioides) in Arizona, The, 301
Baldwinia uniflora, 561
Balsamia, 182
Balsamorhiza sagittata, 342
Baptisia bracteata, 355; perfoliata, 563
Barosma betulina, 107, 110
Batodendron arboreum, 212, 214
Batrachospermum, 161, 167, 171, 172, 173
Bauhinia marylandica, 297
Bazzania deflexa, 598; Didericiana, 597; Pearsoni, 596, 597, 615, 616; tricrenata, 597, 598; trilobata, 598
Belairia **parvifoliola,** 19
BENEDICT, R. C. Revision of the genus Vittaria, J. E. Smith, A, 391
Berberis Aquifolium, 127; repens, 341
Bernhardia dichotoma, 56; ramulosa, 57
BERRY, E. W. Contributions to the Mesozoic flora of the Atlantic coastal plain, X.—Maryland, 295
Besseya alpina, 100, 470; plantaginea, 464; plantaginifolia, 100
Betula glandulosa, 472, 473; lutea, 28, 32, 35, 44; nigra, 28, 33, 35; papyrifera alaskana, 381
BICKNELL, E. P. The ferns and flowering plants of Nantucket,—XII, 71; XIII, 411
Bidens, aristosa, 30, 35
Bignonia crucigera, 214, 560
Bistorta bistortoides, 100, 470, 472; linearifolia, 100, 470; vivipara, 93, 472
BLACK, C. A. Branched cells in the prothallium of Onoclea sinsibilis L., 617
Black-soil prairie station in northeastern Illinois, A., 351
Blasia pusilla, 612
Blephariglottis lacera, 29, 34, 38; peramoena, 29, 31, 35
Blepharoneuron tricholepis, 470
Blepharostoma setiforme, 613; trichophyllum, 601
Boletus, 179
Bonnemaisonia, 167
Bonnetia, 20; anceps, 20
Botrytis cinerea, 290; vulgaris, 290
Bourreria, 10; grandiflora, 11; **moaensis,** 10; **mucronata,** 10; **Nashii,** 11; pauciflora, 11; setoso-hispida, 10
BOWMAN, H. H. M. Mechanical tissue development in certain North American vines, 365
Brachyphyllum macrocarpum, 297; macrocarpum formosum, 297
Brachysiphon, 223
Branched cells in the prothallium of Onoclea sensibilis L., 617
Brassica arvensis, 514, 517
Brauneria pallida, 355; purpurea, 30
Brickellia californica, 303
BRITTON, N. L. Studies of West Indian plants—V, 1
Bromus Kalmii, 356; secalinus, 514
Bryonia alba, 126; dioica, 126
Bryopteris, 608
Bumelia lanuginosa, 214; praenuntia, 298
Bupleurum americanum, 100; purpureum, 100; ranunculoides, 100
Burmannia, 229; candida, 230; Championii, 222, 230; coelestis, 230
Burshia, 497

Cactaceae, 71
Cactus missouriensis, 47; Opuntia, 71

Calamagrostis arundinacea, 95; canadensis, 97, 358, 359; Langsdorfii, 97, 471; purpurascens, 95, 463
Calliandra colletioides, 18; erophylla, 303; prehensilis, 8; revoluta, 5; Saman, 8
Callicarpa americana, 214, 560; Hitchcockii, 12
Callistemon, 153
Callithamnion, 174, 177
Callitriche palustris, 474
Calluna vulgaris, 415, 416, 417; vulgaris pubescens, 417
Calosiphonia, 176
Caltha biflora, 99; cheledoni, 99, 472, 473; leptosepala, 99, 472, 473; rotundifolia, 99, 472, 473
Calypogeia Neesiana, 596; Trichomanis, 596
Campanula americana, 363; lasiocarpa, 102; Parryi, 470; petiolata, 470; rotundi rotundifolia, 339; uniflora, 93, 94, 470
Camptosorus rhizophyllus, 617
Campulosus aromaticus, 560, 565
Cannabis sativa, 107, 121
Capnoides sempervirens, 29, 35
Capsella Bursa-pastoris, 514, 515, 516, 517, 518
Capsicum fastigiatum, 107
Cardamine bellidifolia, 102; rotundifolia, 30
Carduus undulatus, 341; virginicus, 30
Carex, 471; Clarkii, 298; costellata, 28, 35; floridana, 214; sp., 357
Carphephorus Pseudo-Liatris, 561, 563, 567
Carpinus caroliniana, 559
Carpites liriophylli, 297
Carpolithus septloculus, 298
Carthamus tinctorius, 126
Carum Carvi, 107, 127
Cassandra, 421
Cassia acutifolia, 107; angustifolia, 107; Chamaecrista, 354, 360; nictitans, 28, 35
Cassiope Mertensiana, 98, 467; tetragona, 98, 102, 467
Castanea dentata, 28, 33, 35
Castilleja brunescens, 470; coccinea, 356; Haydeni, 99, 463, 464; lancifolia, 470; lauta, 470; miniata, 339; occidentalis, 100, 463; pallida, 99, 100, 102; rhexifolia, 470
Catabrosa aquatica, 474
Ceanothus americanus, 212; sanguineus 339
Celastrophyllum crenatum, 298; undulatum, 298
Celastrus arctica, 298
Centella repanda, 560
Cephalozia bicuspidata, 595; divaricata, 596; leucantha, 596, 615; media, 596; multiflora, 595
Cephaloziella byssacea, 596
Cerastrium alpinum, 94, 96; Behringianum, 96, 99, 467, 470; Earlei, 99, 468; pulchellum, 99, 468; vulgatum, 514, 516, 517, 518, 520
Ceratostoma, 161, 183, 184
Cercis canadensis, 214, 219, 243, 244, 251, 256, 533, 547, 548; Siliquastrum, 224
Cercis, On the relationship between the number of ovules formed and the number of seeds developing in, 243; Further observations, 533
Cercocarpus, 331, 497; alnifolius, 500; argenteus, 500; arizonicus, 502, 503; betulaefolius, 499, 500, 501; betulaefolius Blancheae, 500; betulaefolius typicus, 499; betuloides, 499, 500, 503; breviflorus, 501, 502; brevifolius, 501; brevifolius eximius, 501; Douglasii, 498, 499, 500, 503; flabellifolius, 500, 503; fothergilloides, 497, 498, 499; hypoleucus, 502, 503; intricatus, 502, 503; ledifolius, 502, 503; ledifolius intercedens subglabra, 502; ledifolius intricatus, 502; macrophyllus, 497; macrurus, 498, 503; minutiflorus, 500; mojadensis, 498; montanus, 498, 499, 500, 503; parvifolius, 498, 499, 500; parvifolius paucidentatus, 501; paucidentatus, 501; Pringlei, 498; rotundifolius, 499; Traskiae, 498, 500; Treleasii, 501
Cereus grandiflorus, 124
Chaenactis alpina, 464; Douglasii, 341; pedicularia, 464
Chaetomium, 183; fimeti, 182, 183
Chamaebatia, 331, 497; australis, 497
Chamaecyparis nootkatensis, 580; thyoides, 559, 563, 565
Chamaedaphne calyculata, 414
Chamaenerion angustifolium, 74, 75
Chamaepericlymenum canadense, 86
Cheirinia amoena, 100, 464; asperrima, 100; nivalis, 100, 464; Pallasii, 102; radiata, 100, 464; Wheeleri, 100
Chenopodium album, 514, 515, 516, 517, 518, 519; ambrosioides, 107, 127; hybridium, 512, 515
Chiloscyphus, 614; pallescens, 595; polyanthus, 614; polyanthus rivularis, 595; rivularis, 595
Chimaphila maculata, 28, 33, 411; umbellata, 308, 411, 415
Chiogenes hispidula, 426
Chionanthus virginica, 212, 214
Chloranthus, 232
Choiromyces, 182
Chondrophora nudata, 560, 563
Chondrophylla americana, 467; Fremontii, 469
Chondrosea Aizoon, 94, 466
Chrysanthemum Balsamitae tanacetoides,

514; Leucanthemum pinnatifidum, 515, 518, 519
Chrysoma laricifolia, 303
Chrysopsis alpicola, 464; aspera, 212; graminifolia, 561; mariana, 29, 35
Chrysosplenium alternifolium, 97; americanum, 28, 35; tetrandrum, 97, 468, 469
Cicuta bulbifera, 84; maculata, 84, 359
Cilia aggregata, 341
Cinchona Calisaya, 126; officinalis, 126; succirubra, 126
Cinnamomum Newberryi, 296, 297
Circaea alpina, 28, 32, 35; lutetiana, 82
Cirsium arvense, 518, 519; discolor, 355; Hillii, 356; lanceolatum, 515, 518, 519, 520
Cissites formosus magothiensis, 298; Newberryi, 298
Citrullus Colocynthis, 107, 126, 127
Cladium effusum, 560, 563
Cladonia sp., 212
Cladophlebis socialis, 296
Clavaria sp., 214 215
Claytonia linearis, 339; megarrhiza, 101, 465, 466; perfoliata, 339; sibirica, 339
Clematis hirsutissima, 340
Clementsia rhodantha, 470
Clerodendron calcicola, 12
Clethra alnifolia, 411, 414
Clethraceae, 411
Cliftonia monophylla, 560, 563, 567
Coccolobites cretaceus, 298
Coelopleurum actaeifolium, 85
Coffea, 149; arabica, 149
Colchicum autumnale, 107, 126.
Coleochaete, 192
Coleogyne, 331
Coleosanthus grandiflorus, 340
Collema, 164, 169, 179, 196; microphyllum, 165, 192; pulposum, 157, 159, 162, 163, 164, 166, 192, 197
Collinsia tenella, 339
Collinsonia canadensis, 109
Collomia grandiflora, 341
Colutea obovata, 297; primordialis, 297
Commandra umbellata, 354
Comocladia, 9; acuminata, 9; **cuneata,** 9; Dodonaea, 9; glabra, 9; pinnatifolia, 9; platyphylla, 9
Compsomyces verticillatus, 161
Condrophylla americana, 96; Fremontii, 99; humilis, 99; prostrata, 96
Conium maculatum, 83, 107; sp., 127
Conocephalum conicum, 585
Conopholis americana, 214, 215
Contributions to the Mesozoic flora of the Atlantic coastal plain, X—Maryland, 295
Convallaria, 225
Convolvulus Scammonia, 126; sepium, 355, 358, 360
Conyza squamata, 15
Copernicia, 20; **Cowellii,** 17; hospita, 20; macroglossa, 20; **rigida,** 17
Corallina, 178
Cordia apiculata, 298
Coreopsis major Oemleri, 212
Coriandrum sativum, 85, 107, 127
Cornaceae, 86
Cornus, 363; Amomum, 87, 362; canadensis, 86; cecilensis, 298; florida, 86, 214, 216, 219, 559, 563; Forchhammeri, 298; stolonifera, 28, 36, 338
Corylus americana, 362
Cowania, 495; alba, 495; Davidsonii, 495; ericaefolia, 495; Howardi, 495; mexicana, 495; Stansburiana, 495
Cracca virginiana, 212, 560, 562
Crataegus aestivalis, 566; brevispina, 341; Michauxii, 211, 214; sp. 214, 362
Crepis barbigera, 339; gracilis, 339
Crossosma Bigelovii, 303
Croton, 230; nummulariaefolius, 12
Crotonophyllum cretaceum, 297
Crucianella, 223, 225
Cruoriopsis, 196; cruciata, 175
Cudonia, 180
Cunilla originoides, 28, 33, 35
Cupressinoxylon Bibbinsi, 298
Cuscata californica, 341
Cynoglossum officinale, 514, 515, 518
Cynomorium, 222
Cynoxylon florida, 86
Cyperus comosus, 1; pseudovegetus, 561; sp. 358
Cypripedium, 229; acaule, 28, 32, 35, 36, 415; Reginae, 30
Cyrilla racemiflora, 560, 561, 567
Cytisus scoparius, 107, 124
Czekanowskia capillaris, 296

Dalbergia severnensis, 297
Dammara borealis, 299; cliffwoodensis, 299
Danthonia intermedia, 469
Dasiophora fruticosa, 30, 463
Dasylirion Wheeleri, 302, 303
Dasystephana affinis, 463; frigida, 96; Froelichii, 96; glauca, 95, 468; monticola, 464; Parryi, 464; Romanzovii, 96
Dasystoma laevigata, 28, 33, 35; quercifolia, 214
Datura, 121; ferox, 127; Stramonium, 107, 121, 444; Tatula, 121
Daucus Carota, 86, 360
Decodon verticillatus, 73
Delphinium alpestre, 101, 468; Consolida, 107, 121; Menziesii, 340; Stephisagria, 107, 127
Dendropanax, 9; cuneifolium, 10; **filipes,** 9
Dentaria heterophylla, 28, 35
Denticulatae, 591, 592
Dermonema, 194; dichotomum, 172

Deschampsia alpicola, 98, 469, 470; caespitosa, 93, 96, 98, 469; curtifolia, 96, 463
Desmodium illinoense, 355
Dianthus barbatus, 516
Dichromena latifolia, 560, 566
Digitalis, 115; alba, 116, 122, 123; ambigua, 116, 122, 123; Buxbaumi, 122, 123; canariensis, 116, 122, 123, 124; gloxiniaeflora, 116, 122, 123; gloxiniaeflora alba, 117; gloxiniaeflora rosea, 116; grandiflora, 122, 123; lanata, 116, 122, 123; lutea, 122, 123; macrantha, 122, 123; maculata Iveryana, 116; monstrosa, 122, 123; purpurea, 116, 122; purpurea alba, 122, 123; purpurea maculata superba, 122; purpurea rosea, 122, 123; sibirica, 116, 122, 123
Dilophozia, 589
Dioscorea sp., 214
Diospyros primaeva, 297, 298; rotundifolia, 298; vera, 297; virginiana, 28, 34, 559, 560
Diplophylleia albicans, 602; plicata 602; taxifolia, 602
Diplophyllum albicans, 590, 602, 615; argenteum, 613, 615; imbricatum, 613, 615; ovatum, 602, 615; plicatum, 602, 614; taxifolium, 602
Disporum majus, 339
Dodecatheon Meadia, 29, 32, 35, 356, 357; puberulum, 339
DODGE, B. O. The morphological relationships of the Florideae and the Ascomycetes, 157
Dodonaea angustifolia, 303
Doryanthites cretacea, 298
Douglas Lake, Michigan, The introduced vegetation in the vicinity of, 511
Douglasia montana, 101, 463, 464; nivalis, 101, 465
Draba, 462; alpina, 102; andina, 96, 99, 462, 463; aurea, 463; aureiformis, 464; chrysantha, 464; crassa, 464; crassifolia, 464; densiflora, 462, 463; fladnizensis, 93, 467; glacialis, 94, 96; lonchocarpa, 98, 468; nivalis, 98, 102, 468; oligosperma, 96, 462, 463; Parryi, 468; pectinata, 99; saximontana, 464; streptocarpa, 464, 470
Drosera filiformis Tracyi, 560, 563, 567
Dryas, 483; Drummondii, 462, 464, 483, 484; integrifolia, 483; integrifolia canescens, 483; integrifolia intermedia, 483; octopetala, 462, 463, 483, 484, 490; octopetala intermedia, 483; octopetala argentea, 483, 484; octopetala hirsuta, 483; octopetala minor, 483; tomentosa, 483
Drymocallis agrimonioides, 485; Convallaria, 339; glandulosa, 101; pseudorupestris, 99, 471; pumila, 101; rupestris, 99
Drymoglossum, 397
Dudresnaya, 167, 176, 177, 194, 195, 196; coccinea, 173, 195; purpurifera, 195

Eatonia nitida, 30, 35
Eichhornia, 225
Elaeodendron marylandicum, 298
Elaphomyces, 182
Elephantella, 472; groenlandica, 471, 472
Elettaria Cardamomum, 107, 127
Elymus canadense, 356
Endogone, 157, 192
Epigaea repens, 28, 33, 35, 414
Epilobium adenocaulon, 76; angustifolium, 517, 519; coloratum, 76; hirsutum, 75; lineare, 75, 76; palustre, 75; palustre labradoricum, 75; palustre monticola, 75; strictum, 76
Epipactis, 143, 223, 224, 225, 231; pubescens, 230
Equisetum arvense, 356
Erechtites hieracifolia, 517
Erica cinerea, 418; Tetralix, 416, 417
Ericaceae, 413
Erifonum flavum, 100; xanthum, 100
Erigeron alpinum, 94; annuus, 360; canadensis, 360, 517; compositus, 97, 462, 463; expansus, 15; glabellus, 470; grandiflorus, 102; lanatus, 102; melanocephalus, 96; multifidus, 97, 99, 462, 463; pedatus, 99; pinnatisectus, 462, 464; ramosus, 354, 356; simplex, 96, 462, 463; speciosus, 339; trifidus, 97, 462, 463; unalaschensis, 102; uniflorus, 96
Eriocaulon decangulare, 560, 566, 567
Eriogonum compositum, 341; flavum, 100; heracleoides, 341; niveum, 341, 342; tomentosum, 563; xanthum, 100, 464
Eriophorum gracile, 471; polystachyum, 471
Eriophyllum lanatum, 341, 342
Eritrichium argenteum, 99, 462, 464; elongatum, 99, 463, 464; nanum, 99; villosum, 99
Ernodea, 12; littoralis, 12
Eryngium, 359; yuccifolium, 356, 357, 359
Erysimum asperum, 340
Erythrina Crista-galli, 224; flabelliformis, 303
Erythrocoma, 490, 491, 492; affinis, 492; aliena, 492; arizonica, 492; australis, 492; canescens, 493; ciliata, 490; cinerascens, 492, 493; companulata, 491; grisea, 492; tridentata, 492
Erythronium grandiflorum, 339
Erythrophyllum, 173, 178, 194, 197; delesserioides, 173
Erythroxylum Coca, 107, 126
Eucalyptus attenuata, 298; Geinitzi, 298; latifolia, 298; Wardiana, 298

Eujungermannia, 588
Eupatorium aromaticum, 28, 32, 35; capillifolium, 560, 563; coelestinum, 28, 33, 35; compositifolium, 560, 563; perfoliatum, 358, 359; purpureum, 560; rotundifolium, 28, 32, 35, 560
Euphorbia, 223, 230; corollata, 355, 357; cyparissias, 514; hirsuta, 512; maculata, 512; palustris, 224, 230; procera, 224, 230; virgata, 229
Euthamia grandiflora, 340
Euvittaria, 394, 395
Euxolus emarginatus, 509
EVANS, A. W. Report on the Hepaticae of Alaska, 577
Exoascus, 170

Fagus grandifolia, 213, 216, 219, 512, 559
Fallugia, 496; acuminata, 496; mexicana, 496; micrantha, 496; paradoxa, 496
FARWELL, O. A. The correct name for the hemlock spruce, 621
Fatsia japonica, 222
Fegatella conica, 585
Ferns and flowering plants of Nantucket, The—XII, 71;—XIII, 411
Festuca brachyphylla, 99, 463; ingrata, 469; minutiflora, 99, 464; ovina, 93, 96; rubra, 93, 469; saximontana, 96, 463, 469; supina, 93, 463, 464; Thurberi, 469, 470
Ficus Cecilensis, 298; crassipes, 298; daphnogenoides, 298; Krausiana, 298; ovatifolia, 297
Fimbriaria tenella, 613
FISHER, G. C. Seed development in the genus Peperomia, 137, 221
Foeniculum vulgare, 107, 126, 127
Fontainea grandifolia, 297
Fragaria platypetala, 339; virginiana, 356
Fraxinus americana, 213, 219; nigra, 29, 36; quadrangulata, 28, 36
Frullania chilcootiensis, 613, 615; franciscana, 612, 615; nisquallensis, 590, 607, 612, 614, 615; Tamarisci, 614
Fucus, 229

Gaillardia aristata, 342
Galactinia, 158; succosa, 170
Galega officinalis, 107
Galium Aparine, 339; boreale, 339; sp. 357; uniflorum, 214
Garcinia, 222
Gaultheria procumbens, 28, 33, 34, 36, 414
Gaylussacia baccata, 419; dumosa, 212, 419, 421; dumosa Bigeloviana, 419; frondosa, 419
Geinitzia formosa, 298
Gelsemium sempervirens, 212
Geocalyx graveolens, 595
Geoglossum, 171, 180
Gentiana Andrewsii, 359; crinita, 29, 36; lutea, 126; oregana, 339
Geranium viscossisimum, 339
Geum, 484, 490, 491, 494; agrimonioides, 484, 485; album, 485, 486; album flavum, 486; aleppicum, 488; auranthacum, 489; calthifolium, 494; camporum, 484; canadense, 484, 485, 486; cercocarpoides, 496; ciliatum, 491; decurrens, 486; flavum, 486; florum, 486; geniculatum, 488; Grahami, 492; hirsutum, 486; intermedium, 488; laciniatum, 484; macrophyllum, 487, 488; macrophyllum × oregonense, 489; macrophyllum × rivale, 489; macrophyllum × strictum, 489; mexicanum, 488; Meyerianum, 484, 485, 486; nutans, 488; oregonense, 487; oregonense × strictum, 489; perincisus, 487; pulchrum, 489; Rafinesquianum, 488; rivale, 484, 488, 489, 490; rivale × strictum, 489; rotundifolium, 494; scopulorum, 487; strictum, 363, 486, 487, 488, 489; triflorum, 491; urbanum, 487, 488, 489; vernum, 484; virginianum, 484
Gigartina, 173, 178
Ginkgo biloba, 90
GLEASON, H. A., and MCFARLAND, F. T. The introduced vegetation in the vicinity of Douglas Lake, Michigan, 511
Gleichenia delawarensis, 297; Saundersii, 297; Zippei, 297
Gloiosiphonia, 176, 177, 194
Glyceria nervata, 358, 359, 360
Glycyrrhiza glabra, 126
Gnomonia, 158, 171; erythrostoma, 159
Gonianthes Lindeniana, 23; Sagraeana, 23
Gormania debilis, 101, 464
Graphis elegans, 164
Griffithsia Bornetiana, 167
GRIGGS, R. F. Observations on the behavior of some species at the edges of their ranges, 25; Observations on the edge of the forest in the Kodiak region of Alaska, 381
Grimaldia fragrans, 612
Grindelia robusta, 127
Grossularia hirtella, 415
Gunnera, 137, 138, 223; macrophylla, 137
Gymnadenia, 149, 150; conopsea, 149
Gymnoascus, 171, 193; candida, 159
Gymnocladus dioica, 29, 35
Gymnomitrium concinnatum, 612; corallioides, 612; crenulatum, 612, 615; obtusum, 586, 615
Gyrostachys gracilis, 33
Gyrothyra Underwoodiana, 587, 615

Habenaria nivea, 561
Halesia diptera, 219
Haloragidaceae, 82
Hamamelis virginiana, 214
Haplopappus marginatus, 14
Haplopteris, 393, 394, 395

HARPER, R. M. The "Pocosin" of Pike County, Alabama, and its bearing on certain problems of succession, 209; A superficial study of the pine-barren vegetation of Mississippi, 551
Harrimanella hypnoides, 467
HARRIS, J. A. On the relationship between the number of ovules formed and the number of seeds developing in Cercis, 243; Further observations, 533
Harveyella, 173, 174, 194, 197; mirabilis, 167, 172
Havardia, 8
Hecistopteris, 400; minima, 398; Weckleana, 399
Hedera cecilensis, 298; cretacea, 298; Helix, 367, 368, 370, 371
Hedyosmum, 232
Helenium tenuifolium, 560
Helianthus, 363; angustifolius, 561; annuus, 512; decapetalus, 362; divaricatus, 362; grosse-serratus, 358, 360; Maximiliani, 355; occidentalis, 355; scaberrimus, 355
Heliopsis scabra, 355
Helminthora, 167
Helotium citrinum, 190
Helvella, 179
Hemlock spruce, The correct name for the, 621
Hepaticae of Alaska, Report on the, 577
Heracleum lanatum, 85, 86, 339
Herberta adunca, 597, 601, 615
Heteromallae, 592
Heuchera cylindrica, 339; Hallii, 465; hispida, 356; parvifolia, 463
Hibiscus aculeatus, 561
Hicoria alba, 216, 219, 559; glabra, 211, 213
Hieracium albiflorum, 339; paniculatum, 28, 35; Scouleri, 339; venosum, 28, 33, 35
Hoffmannia aphylla, 56
Hordeum jubatum, 512
Houttuynia, 232
HOWE, R. H., JR. The nomenclature of the genus Usnea, 373
Hulsea carnosa, 465, 466
Humaria granulata, 159; rutilans, 171
Humulus Lupulus, 512
Hydrangea arborescens, 28, 35
Hydrastis canadensis, 109
Hydnocystis, 182
Hydrocotyle umbellata, 83
Hyoscyamus muticus, 126; niger, 107, 125, 444; orientalis, 125
Hypericum Drummondii, 29, 32, 35; fasciculatum, 560; sp. 359
Hypocopra, 161, 183
Hypopitys americana, 412; **insignata**, 413; lanuginosa, 412
Hypoxis hirsuta, 358

Ichmadophila aeruginosa, 159
Ilex coriacea, 216; fastigiata, 414; glabra, 559, 567; myrtifolia, 560, 563, 567; opaca, 214, 216, 219, 559; severnensis, 298
Illicium, 148; deletoides, 298
Impatiens biflora, 339
Inga Hystrix, 4; obovalis, 5
Introduced vegetation in the vicinity of Douglas Lake, Michigan, The, 511
Ionactis linariifolius, 212
Iris, 149; cristata, 29, 35, 36; sibirica, 149; verna, 212; versicolor, 359
Isnardia palustris, 74
Isoetes Bolanderi, 474; paupercula, 474
Isopyrum biternatum, 28, 35
Isotria verticillata, 29, 34
Iva xanthifolia, 512, 514

Jacobinia **jamaicensis**, 16
Jeffersonia diphylla, 109
Juglans, 231
Juncoides arcticum, 102, 471; arcuatum, 102, 471; hyperboreum, 102, 471; parviflorum, 470; saltuensis, 28, 32, 35; spicatum, 93, 94, 467, 470
Juncus, 466; biglumis, 102, 471; castaneus, 93, 467, 470; Drummondii, 467, 470; Parryi, 467, 470; Roemerianus, 560, 563; sp. 357; triglumis, 93, 467, 470
Jungermannia, 588; albicans, 602; albicans taxifolia, 602; atrovirens, 587; caespiticia, 613, 615; cochleariformis, 610; conchaefolia, 611; cordifolia, 587; gigantea, 611; lanceolata, 613; minuta, 588; nemorosa, 606; orcadensis, 588; purpurea, 610; saxicola, 613; setiformis, 613; sphaerocarpa, 613; trichophylla, 601; ventricosa, 613
Jungermanniaceae, 586, 612
Juniperus australis, 11; hypnoides, 298; lucayana, 11; scopulorum, 343

Kalmia, 467; angustifolia, 414; glauca, 97; latifolia, 28, 33, 35, 214, 216, 413; microphylla, 97, 472, 473
Kantia Trichomanis, 596
Kerria, 331; japonica, 367, 370
Kieseria, 20; **cubensis**, 19
Kneiffia pumila, 82
Koeleria cristata, 354, 356
Koellia incana, 28, 35
Krigia amplexicaulis, 356
Kuhnistera pinnata, 212, 563
KUNKEL, L. O. Physical and chemical factors influencing the toxicity of inorganic salts to Monilia sitophila (Mont.) Sacc., 265
Kuntzia, 496, 497; tridentata, 495

Laboulbenia chaetophora, 159
Lachemilla, 319, 320, 321; Bourgeaui,

321; domingensis, 321; ocreata, 321; orbiculata, 320, 321; orizabensis, 321; Pringlei, 321; procumbens, 321; Schiedeana, 321; venusta, 320
Lachnea, 169, 180, 186; abundans, 163, 165, 189, 193; cretea, 159, 160, 165, 167, 172, 189, 193; leucotricha, 189; melaloma, 166, 193; scutellata, 159, 165, 171, 181, 185, 186, 189, 193, 194; stercorea, 159, 164, 181, 185, 186, 189, 192, 193
Lacistema, 232
Lactuca canadensis, 360
Lappula ciliata, 341; deflexa, 512, 514, 515, 518
Larix, 153; sibirica, 222
Lasiobolus, 195; equinus, 159, 160, 193, 194; pulcherrimus, 193, 194
Lasiocroton Fawcettii, 16; **Harrisii**, 16
Lathyrus palustris, 356
Laurus Cinnamomum, 126; Hollickii, 297; plutonia, 297; proteaefolia, 297
Laurophyllum angustifolium, 297; elegans, 297
Lecanora subfusca, 166
Lechea racemulosa, 28, 36
Ledum glandulosum, 467, 472, 473
Leguminosites canavalioides, 297; coronilloides, 297; omphalobioides, 297
Lejolisia, 160
Lemna, 231
Leotia, 171; chlorocephala, 159
Lepachys pinnata, 355, 357, 360
Lepidium apetalum, 512; virginicum, 512, 514, 515, 516, 517, 518, 520
Lepidozia, 599, 600; filamentosa, 598, 600, 615; Pearsoni, 601; reptans, 598, 600; sandvicensis, 598, 599, 600, 601, 614, 615; setacea, 601, 614
Leptandra virginica, 109
Leptasea austromontana, 96, 466; bronchialis, 96, 99; chrysantha, 98, 468; flagellaris, 467; Hirculus, 98, 468, 469, Van Bruntiae, 99, 469
Leptilon canadense, 561
Leptinae, 377
Lespedeza capitata, 355, 360
Levisticum officinale, 126
Liagora, 167
Liatris scariosa, 354, 361; spicata, 358, 359, 360
Lichen articulatus, 376, 377; barbatus, 376, 377; floridus, 374; hirtus, 374, 375; plicatus, 375
Ligusticum Porteri, 472; scoticum, 85
Lilium, 229, 231; canadense, 356
Linum floridanum, 561; intercursum, 415
Liquidambar Styraciflua, 219, 559, 563
Liriodendron Tulipifera, 41, 46, 216, 219, 559
Liriodendropsis constricta, 297
Lithospermum canescens, 355; ruderale, 341
Lloydia serotina, 90, 93, 95, 470
Lobelia inflata, 107, 127; leptostachys, 29, 36; puberula, 29, 35; spicata, 356; syphilitica, 359
Lomatium Grayi, 341; triternatum, 340
Lonicera japonica, 367
Lophiola aurea, 560, 563, 566
Lophocolea cuspidata, 595, 615
Lophozia, 588, 589; attenuata, 613; Floerkei, 587; guttulata, 613; heterocolpa, 613; incisa, 587; inflata, 587; lycopodioides, 613; minuta, 588; obtusa, 613, 615; porphyroleuca, 587; quadriloba, 613; quinquedentata, 588; ventricosa, 613
Ludwigia alternifolia, 74; pilosa, 561
Lupinus albus, 267; microcarpus, 343; Piperi, 341
Lychnis alba, 514, 518
Lycium carolinianum, 12; halimifolium, 367, 368, 369
Lyopodiales, 51
Lycopodiaceae, 51
Lycopodium, 51, 55; alopecuroides, 561; arbuscula, 58; capillaceum, 54; cernuum, 51, 53; clavatum, 29, 32, 35, 36, 38, 51; compactum, 53; complanatum, 29, 33, 35, 36, 37; crassifolium, 54; curvatum, 53; digitatum, 57; erubescens, 51, 52, 53; Haleakalae, 51, 53; javanicum, 52; lucidulum, 28, 33, 35, 36, lucidulum porophilum, 28, 34, 36; macrostachys, 55; Menziesii, 58; nudum, 56; nutans, 51, 54; obscurum, 29, 35, 36, 38; pachystachyon, 54; pachystachyon phyllanthon, 54; pennigerum, 58; Phlegmaria, 51, 53; phyllanthum, 51, 54, 55; polytrichoides, 52, 56; Sabinae-facie, 57; sargassifolium, 52; selaginoides, 57; serratum, 51, 52, 58; serratum dentatum, 52; serratum subintegrum, 52; squarrosum, 54; suberectum, 53; sulcinervium, 52; varium, 52; venustulum, 52, 55; venustulum herpeticum, 55; volubile, 52, 55
Lysias orbiculata, 30
Lysimachia quadrifolia, 28, 34
Lythraceae, 73
Lythrum Salicaria, 73; Salicaria tomentosum, 73

Machaeranthera canescens, 342; Pattersoni, 465
Macronema Lyallii, 465; pygmeum, 464
Madotheca navicularis, 611; platyphylla, 613
Magnolia acuminata, 219; Boulayana, 298; capellinii, 298; glauca, 216, 559;

grandiflora, 213, 216, 219, 559, 563; Hollicki, 298; Lacoeana, 298; longipes, 298; macrophylla, 219, 559, 563, 566; obtusata, 298; pyramidata, 219; tenuifolia, 298
Mairania alpina, 102
Malva rotundifolia, 514, 516
Marchantia, 333; polymorpha, 585, 615
Marchantiaceae, 585
Marsupella emarginata, 586; sphacelata, 612
Maryland, Contributions to the Mesozoic flora of the Atlantic coastal plain, —X., 295
Mastigobryum Didrichsenii, 597; Pearsoni, 596; deflexum, 598
Maytenus phyllanthoides, 12
McFARLAND, F. T., GLEASON, H. A., and, Introduced vegetation in the vicinity of Douglas Lake, Michigan, The, 511
Mechanical tissue development in certain North American vines, 365
Medicinal plants, The propagation of, 105
Meibomia angustifolia, 19; **Cowellii**, 19
Melampyrum lineare, 29, 32, 35
Melanospora, 161, 183, 184
Melastomaceae, 74
Melilotus alba, 360
Mentha canadensis borealis, 339
Mentzelia integrifolia, 342; laevicaulis, 342
Mertensia alpina, 466, 467, 471; Bakeri, 100, 468; brevistyla, 468, 471; Drummondii, 102; lanceolata, 100; lateriflora, 100, 468; nivalis, 100; oblongifolia, 339; Parryi, 100, 468; viridula, 100, 468
Mesinae, 374
Mesozoic flora of the Atlantic coastal plain, Contributions to the, X.—Maryland, 295
Mesophylla orcadensis, 588
Metzgeriaceae, 585
Metzgeria conjugata 586, 590, 593, 607; hamata, 612, 614, 615; pubescens, 586
Micranthes arnoglosa, 98, 468; brachypus, 468; crenatifolia, 98, 469; foliolosa, 102; hieracifolia, 94, 98, 469; nivalis, 94, 98, 102; rhomboidea, 98, 467; Rydbergii, 98, 468; stellaris, 468; Vreelandii, 468, 469
Microglossum, 180
Microlepidozia, 614
MILLER, F. A. The propagation of medicinal plants, 105
Mimosa arborea, 7; biuncifera, 303; circinalis, 3; filicifolia, 7; Saman, 8; Unguis-cati, 3
Mitchella repens, 214
Mitrula, 180
Monarda, 109; mollis, 356, 363
Monilia sitophila (Mont.) Sacc., Physical and chemical factors influencing the toxicity of inorganic salts to, 265
Monilia sitophila, 266, 268, 269, 272, 275, 277, 281, 283, 284, 286, 289
Monotropaceae, 412
Monotropa, 149, 150; Hypopitys, 149; uniflora, 214, 215, 412
Morchella, 169
Moriconia americana, 298
Morphological relationships of the Florideae and the Ascomycetes, The, 157
Morus, 148, 149, 150; alba, 146, 147, 148
Mosaic disease of tobacco, A review of investigations of the, together with a bibliography of the more important contributions, 435
Mucor, 179; Mucedo, 286, 290
Muscaria adscendens, 93, 467; caespitosa, 98, 102, 468; delicatula, 98, 468; micropetala, 98, 468; monticola, 98, 469
Muscus clavatus, 57
Mylia anomala, 595; Taylori, 595
Myosotis alpestris, 93, 466, 467
Myrica cerifera, 560; inodora, 566; longa, 298; pumila, 560
Myriophyllum humile, 82; tenellum, 82
Myrsine borealis, 298; Gaudini, 298

Nantucket, The ferns and flowering plants of,—XII, 71; XIII, 411
Napaea dioica, 29, 34, 38
Nardia compressa, 613, 615; Geoscyphus, 613, 615; haematosticta, 613; obovata, 613, 615; scalaris, 587
Nelumbites primaeva, 297
Nemalion, 167, 171, 172, 174, 194, 195
Nepeta Cataria, 514, 515, 516, 518, 519
New or notable species of Amaranthus, 505
Nicandra physaloides, 125
Nomenclature of the genus Usnea, The, 373
North American ferns, Notes on two, 307
Notes on Rosaceae—VII, 319; VIII, 483
Notes on two North American ferns, 307
Nyssa biflora, 559, 560; Ogeche, 563; sylvatica, 87, 211, 219, 559, 563; uniflora, 559, 563

Observations on the behavior of some species at the edges of their ranges, 25
Observations on the edge of the forest in the Kodiak region of Alaska, 381
Oedocephalum albidum, 290
Oedogonium, 167
Oenothera, 229, 366, 371; albida, 81; biennis, 76, 77, 78, 80, 355; biennis parviflora, 79; canovirens, 78; cruciata, 80; Lamarckiana, 80, 81, 366; muricata,

76, 77, 80; Oakesiana, 78, 80; rubrinervis, 366; **stenopetala**, 79, 80; strigosa, 77; subulifera, 78
Oetosis, 395, 396, 397
Onagraceae, 74
Onoclea inquirenda, 297; sensibilis, 618; Struthiopteris, 617
Onoclea sensibilis L., Branched cells in the prothallium of, 617
Onosmodium, 497
On the relationship between the number of ovules formed and the number of seeds developing in Cercis, 243; Further observations, 533
Opulaster pauciflorus, 339
Opuntia, 71, 72; Opuntia, 72; polyacantha borealis, 343; vulgaris, 72, 212, 214
Orchis, 150; latifolia, 149; Morio, 149
Oreobroma pygmaea, 463
Oreocarya sericea, 342
Oreochrysum Parryi, 468, 471
Oreoxis alpina, 101, 464; Bakeri, 101, 464; humilis, 101, 464
Origin of the alpine flora. Phytogeographical notes on the Rocky Mountain region, II, 89
Ornithogalum, 229
Osmanthus americana, 212, 214, 216
Osmunda cinnamomea, 561; delawarensis, 297
Ostrya virginiana, 214, 219
Oxalis stricta, 358
Oxycoccus, 472; macrocarpus, 426; Oxycoccos, 426
Oxydendrum arboreum, 28, 33, 35, 37, 214, 219, 559, 562, 563
Oxypolis filiformis, 560, 567; rigidior, 356, 359, 363
Oxyria digyna, 93, 465, 466, 467

Pallavicinia Flotowiana, 586, 615; hiberica, 586
Panicularia acutiflora, 30; elongata, 30, 36; pallida, 30
Panicum capillare, 512; dichotomum, 561; nitidum, 357; polyanthes, 28, 35; Scribnerianum, 356; sp., 214, 357; stipitatum, 30, 35; virgatum, 354
Papaver somniferum, 107
Parnassia caroliniana, 29, 36
Paronychia pulvinata, 101, 464
Parrya macrocarpa, 98; platycarpa, 98, 464
Parthenium integrifolium, 356, 357, 359
Passiflora incarnata, 107; lutea, 29, 34, 38
Pastinaca sativa, 85
Pedicularis canadensis, 356; flammea, 102; lanata, 102; lanceolata, 29, 35; Oederi, 102; Parryi, 470; racemosa, 470
Pellaea ternifolia, 308
Pellia endiviaefolia, 612; epiphylla, 612; Fabroniana, 612; Neesiana, 586
Penaea, 223
Penicillium, 170, 173, 178; crustaceum, 289; glaucum, 290
Pentstemon confertus, 339; Hallii, 464, 465; Harbourii, 465; stenosepalum, 468
Peperomia, Seed development in the genus, 137, 221
Peperomia, 137, 138, 140, 141, 146, 148, 150, 151, 152, 154, 156, 221, 222, 223, 224, 225, 226, 229, 230, 231, 232, 233, 234; arifolia, 140, 143, 223, 224; blanda, 138, 139, 154, 225; Fraseri, 153; Fraseri resediflora, 138, 139, 153, 225; galioides, 138, 139, 155, 225; hispidula, 137, 142, 223; humilis, 139; ionophylla, 140; Langsdorffii, 138, 139, 155, 225; metallica, 138, 139, 152, 153; Ottoniana, 223; pellucida, 137, 138, 142, 144, 223; pulchella, 145; reflexa, 138, 139, 145, 146, 150, 151, 152, 154, 155, 225; resedaeflora, 139, 153; scandens, 138, 150, 151, 225; Sintenisii, 143, 223, 224; urocarpa, 140; verticillata, 138, 139, 145, 147, 148, 149, 151, 152, 154, 225
Peronospora, 160
Persea Borbonia, 214
Pertusaria communis, 159
Petalostemum purpureum, 355
Petrocelis, 176
Petroselinum hortense, 84
Petunia nyctaginifolia, 444
Phacelia alpina, 100, 464, 471; ciliosa, 470; dubia, 29, 32, 35; heterophylla, 100, 342; Lyallii, 99, 465; sericea, 99, 464, 470
Phallus, 179
Phaseolus, 256, 548; multiflorus, 224; vulgaris, 243, 548
Philadelphus Lewisii, 341
Phippsia algida, 97, 474
Phleum alpinum, 93, 94, 469, 471; pratense, 360, 514, 515, 516, 518, 519, 520
Phlox, 462; caespitosa, 100, 462, 463; condensata, 100, 462, 464; glaberrima, 356; pilosa, 356, 358; stolonifera, 29, 32, 34, 36, 38
Phoradendron flavescens, 560
Phragmites communis, 359
Phycomyces nitens, 286
Phyllactinia corylea, 159
Phyllanthus, 230
Phyllodoce, 467; coerulea, 98; empetriformis, 98, 472, 473; glanduliflora, 98, 472, 473
Physalis virginiana, 354
Physaria Geyeri, 342
Physical and chemical factors influencing the toxicity of inorganic salts to Monilia sitophila (Mont.) Sacc., 265
Physiotium cochleariforme, 610
Physostegia virginiana, 358

Physma compactum, 192
Phytogeographical notes on the Rocky Mountain region, II. Origin of the alpine flora, 89; III. Formations in the alpine zone, 459
Picea alba, 628; balsamea, 628; canadensis, 621, 628, 629; mariana, 628; nigra, 628; sitchensis, 381, 580
Pimpinella Anisum, 107, 127
Pine-barren vegetation of Mississippi, A, superficial study of, 551
Pinus, 153; alba, 628; americana, 628; balsamea, 623, 624, 625, 626, 627, 628; canadensis, 621, 622, 623, 625, 626, 627, 628, 629; contorta, 343; echinata, 211, 559, 563; Elliottii, 559, 563, 564; glabra, 219, 559, 563, 565; mariana, 628; nigra, 628; palustris, 211, 551, 559, 561; ponderosa, 342; rigida, 29, 32, 33, 35; serotina, 209, 563; Taeda, 219, 559, 563, 565; virginiana, 29, 33, 35
Piper, 137, 138, 140, 141, 153, 155, 156, 229, 231, 232; Betle monoicum, 156; medium, 156; nigrum, 126; tuberculatum, 138, 155, 156, 233; umbellata, 156
Pistia Nordenskioldi, 298
Pitcheria galactioides, 212
Pithecolobium, 2; arboreum, 3, 7; asplenifolium, 3, 6; bahamense, 2, 4; Berterianum, 3, 8; brevifolium, 8; calliandrifolium, 4; circinale, 2, 3; **discolor,** 2, 4; filicifolium, 7; guadalupense, 2, 4; **guantanamense,** 3, 7; Hystrix, 2, 4; latifolium, 8; mucronatum, 3; **nipense,** 3, 6; obovale, 2, 5; **pinetorum,** 2, 6; prehensile, 3, 8; Saman, 3, 8; **savannarum,** 2, 4; tortum, 3, 8; **trinitense,** 3, 7; **truncatum,** 2, 5; Unguis-cati, 2, 3; vincentis, 8
Plagiochila, 589, 591, 594; **alaskana,** 590, 591, 592, 594, 595, 615; asplenioides, 590; fragilis, 592, 593; **Fryei,** 593, 594, 595, 615; oxyphylla, 592, 593; pachyloma, 592, 593; renitens, 591, 592; trapezoidea, 591, 592
Plantago lanceolata, 514, 515; major, 512, 514, 515, 516, 518, 519
Platanus, 297; Heerii, 297
Pleuroschisma Pearsoni, 596
Pleurozia, 610; cochleariformis, 610; conchaefolia, 611; gigantea, 611; purpurea, 610, 611, 614, 615, 616
Poa, 469; alpicola, 470; alpina, 93, 94, 467; annua, 515; arctica, 96, 99, 467; Buckleyana, 469; cenisia, 93, 96, 467; compressa, 356, 357, 363, 514, 515, 516, 518, 520; crocata, 100, 101, 463; epilis, 464, 469; Grayana, 470; leptocoma, 469, 471; Lettermannii, 101, 463, 464; longiligula, 469; Pattersonii, 100, 463, 464; pratensis, 360, 512, 514, 515, 516, 518, 519, 520, 521; pudica, 99, 470; reflexa, 471; rupicola, 101, 463; Sheldoni, 470
"Pocosin" of Pike County, Alabama, and its bearing on certain problems of succession, The, 209
Podostemon, 229
Podozamites Knowltoni, 297; lanceolatus, 296; marginatus, 296
Polemonium, 466; Brandegei, 101, 468; confertum, 101, 465, 468, 470; delicatum, 99, 466; Grayanum, 101; humile, 96; mellitum, 101, 470; micranthum, 343; parviflorum, 99, 469; pulcherrimum, 96, 99, 466, 467; speciosum, 101, 465, 470; viscosum, 101, 466, 468, 471
Polygala cruciata, 561; cymosa, 560, 566; ramosa, 560, 567
Polygonatum biflorum, 214
Polygonum amphibium Hartwrightii, 360; arifolium, 32, 35; aviculare, 512, 514, 515, 518, 520; convolvulus, 514, 515, 517, 518, 519; erectum, 512; Persicaria, 514, 515, 518; sp. 356
Polyides, 167, 173, 176
Polypodium, 391; polypodioides, 212, 214
Polysiphonia, 167, 174
Polystigma, 158, 171, 191
Populus balsamifera, 381, 580; deltoides, 359; grandidentata, 511; stygia, 298; tremuloides, 29, 36; trichocarpa, 338, 340
Porella, 608; navicularis, 611, 615; platyphylla, 613; rivularis, 612; Roellii, 612, 615
Poronia punctata, 159
Porteranthus stipulatus, 29, 35
Portlandia, 21; coccinea, 21, 23; coriacea, 23; daphnoides, 21, 23, 24; **domingensis,** 21, 24; **elliptica,** 21, 22; grandiflora, 21, 22; gypsophila, 23; Harrisii, 21, 22; involucrata, 21, 22; **Lindeniana,** 21, 23; longiflora, 23; nitens, 21, 22; pendula, 21, 23; **sessilifolia,** 21; uliginosa, 21, 22
Portulaca oleracea, 517
Potamogeton alpinus, 474
Potentilla, 92, 495; arguta, 485; decurrens, 100; diversifolia, 100, 470; emarginata, 102; glaucophylla, 470; Macounii, 464; minutiflora, 101; minutifolia, 464; modesta, 98; nipharga, 96, 464; nivea, 90, 92, 93, 96, 98, 464; paucijuga, 464; perdissecta, 100; quinquefolia, 96, 98, 462, 463; Robbinsiana, 92; rubripes, 470; saximontana, 101; tenerrima, 101, 464; uniflora, 93, 102; villosa, 93, 102
Poteridium, 322; annuum, 322, 323; occidentalis, 323
Poterium, 323; annuum, 323; Sanguisorba, 323; spinosum, 323

Preissia hemisphaerica, 585; quadrata, 585
Primula angustifolia, 100, 467, 470; Broadheadae, 100; farinosa, 90; Parryi, 465, 470, 472
Prionitis, 194, 197; Lyallii, 174
Propagation of medicinal plants, The, 105
Proserpinaca palustris, 82
Prosopis velutina, 303
Protophyllocladus lobatus, 297; subintegrifolius, 297
Protophyllum, 296, 297; multinerve, 297; Sternbergii, 297
Prunus americana, 362; caroliniana, 214; demissa, 340; serotina, 213; umbellata, 214
Psedera quinquefolia, 363, 366, 369
Pseudocymopterus montanus, 100; purpureus, 471; Tidestromii, 100, 464
Pseudopteryxia anisata, 465; Hendersonii, 466
Pseudotsuga taxifolia in arid parts of Washington, Slope exposure as a factor in the distribution of, 337
Pseudotsuga taxifolia, 337, 338, 339, 340, 343, 344
Psilotaceae, 56
Psilotum, 56; complanatum, 56, 57; nudum, 56; oahuensis, 56; triquetrum, 56
Psoralea Onobrychis, 29, 36
Psychotria, 11; ligustrifolia, 11; pulverulenta, 11; Sulzneri, 11; undata, 11
Pteridium aquilinum, 212
Pteridophyta of the Hawaiian Islands, A taxonomic study of the,—IV, 51
Pteris, 395, 396, 397; lanceolata, 397; lineata, 393, 394, 395, 397; piloselloides, 397; scolopendrina, 394
Pteropsis, 397
Ptilidium californicum, 601, 615; ciliare, 602; pulcherrimum, 602
Ptilimnium capillaceum, 84
Ptiloria exigua, 342
Puccinia Helianthi, 267
Pulsatilla, 490
Purshia, 331, 496, 497
Pustularia vesiculosa, 169
Pycnanthemum virginianum, 356, 363
Pyrenula, 191
Pyrethrum cinerarifolium, 126
Pyrola americana, 411, 415; chlorantha, 411, 415; elliptica, 29, 33, 34; rotundifolia, 29, 32, 34; uliginosa, 472
Pyrolaceae, 411
Pyronema, 158, 160, 161, 163, 164, 166, 167, 169, 171, 179, 180, 181, 184, 186, 188, 190, 192, 193, 194, 196; confluens, 159, 190
Pyrus coronaria, 362

Quamasia hyacinthina, 29, 35
Quercus alba, 213, 219; aquatica, 214; arkansana, 214; Catesbaei, 211, 559, 563, 566; cinerea, 211, 559, 563; falcata, 559; geminata, 559, 563; laurifolia, 213, 559; Margaretta, 211, 214; marylandica, 211, 214, 559, 563; Michauxii, 559; microcarya, 214; minor, 29, 34, 38; Morrisoniana, 298; myrtifolia, 214; nigra, 214, 219, 559; oblongifolia, 303; Phellos, 559; Prinus, 29, 33, 35; pumila, 563, 566; rubra, 219; severnensis, 298; sp. 214; stellata, 211, 559; velutina, 213; virginiana, 559
Quillaja Saponaria, 126

Radiovittaria, 391, 393, 397, 400
Radula arctica, 606, 607, 613, 615; Bolanderi, 606, 607, 609, 615; cochleariformis, 610; complanata, 613; Krausei, 613; **polyclada**, 607, 608, 609, 610, 615; prolifera, 609, 610; spicata, 607
Ramona incana, 341
Ranunculus, 466; adoneus, 101, 473; affinis, 96, 472; alismaefolius, 473; eximius, 473; glaberrimus, 339; hyperboreus, 97, 467; Macauleyi, 98, 468; nivalis, 98; pedatifidus, 96; pygmaeus, 93, 467; saxicola, 468; stenolobus, 101, 472, 473
Raritania gracilis, 298
Relationship between the number of ovules formed and the number of seeds developing in Cercis, On the, 243; Further observations, 533
Report on the Hepaticae of Alaska, 577
Review of investigations of the mosaic disease of tobacco, together with a bibliography of the more important contributions, A, 435
Revision of the genus Vittaria J. E. Smith, A, I. The species of the subgenus Radiovittaria, 391
Rhamnites apiculatus, 298
Rhexia Alifanus, 560, 565, 567; glabella, 567; lutea, 561; virginica, 74
Rhodiola, 466; integrifolia, 96, 99, 467; polygama, 99, 468; rosea, 96
Rhododendron maximum, 28, 29, 30, 32, 35, 41
Rhodotypus, 331
Rhus copallina, 560, 563; glabra, 363, 560, 563; glabra occidentalis, 341; mollis, 303; radicans, 214; Toxicodendron, 341, 363; Toxicodendron radicans, 366, 368
Ribes aureum, 340; montigenum, 465, parvulum, 465, 466
Riccardia, 599, 601; latifrons, 585; major, 612, 615; multifida, 586, 615
Riccia crystallina, 333; Frostii, 333; natans, 333

Ricciocarpus natans (L.) Corda, The appearance of polar bodies in the spermogenous tissue of, 333
Ricciocarpus natans, 333, 335
Ricinus, 230; communis, 107
Robinia, 548
ROBINSON, W. J. A taxonomic study of the Pteridophyta of the Hawaiian Islands—IV, 51
Roripa Nasturtium, 330
Rosaceae, Notes on, VII, 319; VIII, 483
Rosa humilis, 354, 357, 363; polyantha, 367, 370
Rubus idaeus aculeatissimus, 517; nigrobaccus, 560; occidentalis, 363, 367, 370; odoratus, 29, 34, 38; sp. 363
Rudbeckia hirta, 355, 366, 367, 512
Rumex Acetosella, 515, 516, 518, 519, 520 elongatus, 514, 515, 516, 518
RYDBERG, P. A. Notes on Rosaceae—VII, 319; VIII, 483; Phytogeographical notes on the Rocky Mountain region, II. Origin of the alpine flora, 89; III. Formations in the alpine zone, 459
Rydbergia Brandegei, 101; grandiflora, 101, 469, 470
Rynchospora axillaris, 561; Baldwinii, 561; Chapmani, 560; corniculata, 561; cymosa, 1; elongata, 2; glomerata, 30, 36; **jamaicensis**, 1; polyphylla, 2; semiplumosa, 561

Sabalites magothiensis, 298
Sabbatia angularis, 561; campanulata, 560; decandra, 567; gentianoides, 567; macrophylla, 560, 563, 567
Saccobolus, 193
Sagina nivalis, 97, 468; saginoides, 467
Sagittaria lancifolia, 561
Salix, 231, 472; alexensis, 102, 473; amygdaloides, 29, 35; anglorum, 99; arbusculoides, 102, 473; arctica, 99; Barrattiana, 102, 473; cascadensis, 99, 467, 468; chlorophylla, 95, 472; Dodgeana, 99, 467, 469; Drummondiana, 102, 473; flexuosa, 298; glaucophylla, 230; glauca, 95; glaucops, 95, 99, 472; Lesquereuxii, 296, 298; longifolia, 359; monticola, 472; nigra, 559; nivalis, 98, 467, 468; petrophila, 467; phyllicifolia, 95; pseudolapponum, 99, 468; reticulata, 93, 98; retusa, 99; saximontana, 98, 467, 472; Scouleriana, 338
Salsola Kali tenuifolia, 517
Sambucus canadensis, 362; glauca, 339; pubens, 29, 34; racemosa, 517
Sanguinaria, 548
Sanguisorba, 322, 323; canadensis, 322; latifolia, 322; media, 322; Menziesii, 322; microcephala, 322; officinalis, 322; sitchensis, 322
Sanicula canadensis, 83; marylandica, 83; sp. 214
Santalum album, 126
Sapotacites Knowltoni, 298
Saprolegnia mixta, 290
Sarcocolla, 223
Sarcopoterium, 323
Sarcoscyphus sphacelatus, 613
Sarracenia flava, 563, 566; psittacina, 561, 563, rubra, 566; Sledgei, 560, 563, 566
Sassafras acutilobum, 296, 297; varifolium, 560, 563
Satureja Acinos, 516
Sauteria alpina, 612
Saururus, 141, 229, 232; cernuus, 561
Saxifraga, 466; cernua, 94, 98, 467; debilis, 98, 468; pennsylvanica, 29, 35; rivularis, 98, 102, 468; simulata, 98; virginiensis, 29, 33, 35
Scapania albescens, 603; Bolanderi, 602, 615; cordifolia, 577, 603, 604, 605, 615; curta, 613; dentata, 603, 604, 605; imbricata, 613; irrigua, 606; nemorosa, 606, 615; paludosa 605; paludosa papillosa, 603, 605; planifolia, 616; uliginosa, 605, 606, 615; umbrosa, 606, 615; undulata, 603, 606
Schizonotus discolor, 339
Schoenocaulon officinale, 107, 127
Scilla, 224; maritima, 126
Scinaia, 177
Scirpus caespitosus, 472; cubensis, 1; lineatus, 359; pauciflorus, 472
Scleria Baldwinii, 561
Scleroderma, 179
Scutellaria galericulata, 29, 35; grandiflora, 341, 342; lateriflora, 107, 339
Sebastiana ligustrina, 214
Secale cereale, 516, 518, 520
Securinega, 230
Sedum acre, 514; stenopetalum, 339, 462, 463
Seed development in the genus Peperomia, 137, 221
Selaginella, 55, 57; arbuscula, 58, 59; deflexa, 57, 58; densa, 465, 466; flabellata, 58, 59; Menziesii, 58, 59; parvula, 59; Springii, 58, 59
Selaginellaceae, 57
Senecio, 466; amplectens, 471; atratus, 472; aurens, 97; Balsamitae, 358, 359; carthamoides, 465; crocatus, 468; cymbalarioides, 97, 467; Fremontii, 465, 466; Harbourii, 464; Holmii, 101, 468; hydrophilus, 339; invenustus, 465; lugens, 102; Nelsonii, 464; petrocallis, 101, 464, 466; pseudaureus, 470; Porteri, 101; Purshianus, 463; Soldanella, 101, 468; taraxacoides, 101, 468
Sequoia ambigua, 298; heterophylla, 298; Reichenbachi, 298

Serenoa, 563; serrulata, 559, 566
Sericocarpus asteroides, 29, 33, 35
Setaria viridis, 514, 515, 516
Sibbaldia procumbens, 321, 466, 467
Sidalcea candida, 470
Sieversia, 489, 490, 494; anemonoides, 489, 490, 491; brevifolia, 491, 493; calthifolia, 490, 493, 494; calthifolia congesta, 493; campanulata, 491; canescens, 491, 492, 493; ciliata, 339, 343, 370, 490, 491, 492, 493; flavula, 491, 493; glacialis, 491; grisea, 491, 492, 493; macrantha, 494; montana, 490, 493; Peckii, 92, 490, 493; pentapetala, 490, 491; radiata, 493; radicata, 490; rosea, 492; triflora, 491, 492, 493
Silene acaulis, 93, 463, 463; Douglasii multicaulis, 339; noctiflora, 514, 515, 517, 518; rotundifolia, 29, 30, 32, 35, 44, 45
Silphium, 358, 359; integrifolium, 355, 356; laciniatum, 354, 355, 363, 512; terebinthinaceum, 356, 357, 359, 363, 512
Siphonychia sp. 212
Sisymbrium altissimum, 514, 515, 518; officinale leiocarpum, 514, 515
Sisyrinchium sp., 357
Sium cicutaefolium, 84
Slope exposure as a factor in the distribution of Pseudotsuga taxifolia in arid parts of Washington, 337
SLOSSON, M. Notes on two North American ferns, 307
Smelowskia americana, 96, 462, 463; calycina, 96
Smilacina, 223, 231; stellata, 223, 224, 225
Smilax echirrata, 29, 36; laurifolia, 560; pumila, 214, 216
Solanum Dulcamara, 124, 339; nigrum, 514, 517, 519; tuberosum, 444
Solidago bicolor, 33; canadensis, 354, 357; ciliosa, 101, 470; decumbens, 101, 470; erecta, 30, 35; juncea, 29, 35; nemoralis, 354; odora, 212, 214; ohioensis, 359; oreophila, 101, 470; Riddellii, 359; rigida, 354, 356, 357; scopulorum, 101; serotina, 354
Sonchus alpinus, 624; asper, 517
Sorghastrum nutans, 354, 357, 360; secundum, 212
Sparganium angustifolium, 474; minimum, 474
Spartina Michauxiana, 358, 359; polystachya, 561
Spathularia, 180; stellaris, 98; Vreelandii, 98
Spermacoce floridana, 13; keyense, 13
Sphaeralcea rivularis, 340
Sphaerites raritanensis, 297
Sphaerosoma, 189
Sphaerotheca, 170, 182, 192, 193, 194; Castagnei, 159
Sphenolobus exsectus, 588; minutus, 588; saxicola, 613
Sphenopholis obtusata, 308
Spiraea corymbosa, 339
Spiranthes cernua, 356
Spirogyra, 267; communis, 290
Sporobolus heterolepis, 354, 356, 357, 360
Sporodinia grandis, 286
Stachys cordata, 29, 35; palustris, 339, 358
STANDLEY, P. C. New or notable species of Amaranthus, 505
Staphylea, 548
Stenophyllus ciliatifolius, 212
Stenostomum myrtifolium, 12
Steironema ciliatum, 339, 340
Sterculia cliffwoodensis, 298; minima, 298
Sterigmatocystis nigra, 290
Stigmatomyces Baeri, 161
Stipa spartea, 354, 356, 357
Stokesia laevis, 560, 563, 567
Strophanthus hispidus, 127; Kombe, 127; sp., 127
Strychnos Nuxvomica, 107, 126
Studies of West Indian plants—V, 1
Stylopus, 484; vernus, 484
Stylosanthes biflora, 29, 34, 38
Sullivantia Sullivantii, 29, 32, 35
Superficial study of the pine-barren vegetation of Mississippi, A, 551
Swertia palustris, 96, 472; perennis, 96
Symplocos tinctoria, 216, 219
Syntheris plantaginea, 465
Synthyris rubra, 339

Taeniopsis, 394
Taeniopteris, 394, 395
Taraxacum, 148, 149; arcticum, 98; officinale, 514, 515, 516, 517, 518, 519, 520, 521; scopulorum, 98, 466, 467
Taxodium ascendens, 565; distichum, 90, 559, 563, 565; imbricarium, 559, 563, 565
Taxonomic study of the Pteridophyta of the Hawaiian Islands—IV, A, 51
Tecoma radicans, 367, 369, 370; stans, 303
Teichospora, 196
Telesonix heucheriformis, 101, 465, 466; Jamesii, 101, 465
Tellima parviflora, 339; tenella, 339
Temnoma setiforme, 613
Tephrosia virginiana, 355
Thalictrum alpinum, 93, 470, 472; dasycarpum, 358, 359, 363
Thaspium aureum, 359
Thecotheus, 160, 190, 193; Pelletieri, 159, 192, 193
Thelebolus, 170, 179, 190, 194, 196; stercorarius, 159

Theobroma Cacao, 127
Thlaspi alpestre, 100; coloradense, 100, 462, 464; glaucum, 100; purpurascens 100, 462, 464
Thrinax microcarpa, 11
Thuidium sp. 214, 216
Thuja cretacea, 298; occidentalis, 512; plicata, 343
Thurberia thespesioides, 301, 302, 303, 304, 305
Tigarea, 496
Tilia heterophylla, 212, 219
Tillandsia usneoides, 212, 214, 560
Tium alpinum, 470
Tobacco, A review of investigations of the mosaic disease of, together with a bibliography of the more important contributions, 435
Tofieldia coccinea, 102; palustris, 95, 471; racemosa, 560
Tonestus Lyallii, 101; pygmaeus, 101, 468
Tradescantia reflexa, 356
Tremella, 179
Trichomanes hymenoides, 307; Krausii, 307; Petersii, 307; punctatum, 307
Trichostema dichotomum, 29, 35
Trifolium attenuatum, 101, 468; bracteolatum, 101, 468; Brandegei, 101, 467, 468; dasyphyllum, 101, 462, 463, 468; Haydeni, 471; hybridum, 514, 515, 516, 518, 519, 520; lividum, 101, 468; montanense, 101; nanum, 101, 470; Parryi, 101, 467, 470; pratense, 360, 514, 515, 516, 517, 518, 520; reflexum, 30; repens, 360, 514, 515, 516, 518, 519, 520; salictorum, 101; stenolobum, 101, 468
Trilisa odoratissima, 561
Trillium Hugeri, 214; petiolatum, 339
Triplasis americana, 212
Trisetum majus, 469; subspicatum, 93, 94, 463, 469
Trollius laxus, 30
Tsuga **americana,** 629; canadensis, 29, 33, 35, 45, 512, 621, 622, 629; heterophylla, 580; Mertensiana, 580
Tuber, 169, 179; excavatum, 182; puberulum, 182
TURESSON, G. Slope exposure as a factor in the distribution of Pseudotsuga taxifolia in arid parts of Washington, 337
Typha, 231; latifolia, 359

Umbelliferae, 83
Unifolium canadense, 29, 34, 36, 38
Usnea, The nomenclature of the genus, 373
Usnea, 169, 373; articulata, 374, 376, 377; barbata, 159, 373, 374, 376, 377-barbata articulata, 373; barbata cera; tina, 373; barbata dasypoga, 373a barbata florida, 373; barbata florida hirta, 373; barbata florida rubiginea, 373; barbata florida strigosa, 373; barbata hirta, 373; barbata intermedia, 378; barbata plicata, 373; barbata rubiginea, 373; barbata **stricta,** 378; californica, 376; ceratina, 374, 375, 376, 377, 378; coralloides, 376; dasypoga, 374, 376; dasypoga plicata, 374, 377; florida, 374, 375, 377; florida hirta, 375; plicata, 374, 375, 377; plicata barbata, 374; plicata dasypoga, 377
Utricularia vulgaris, 474

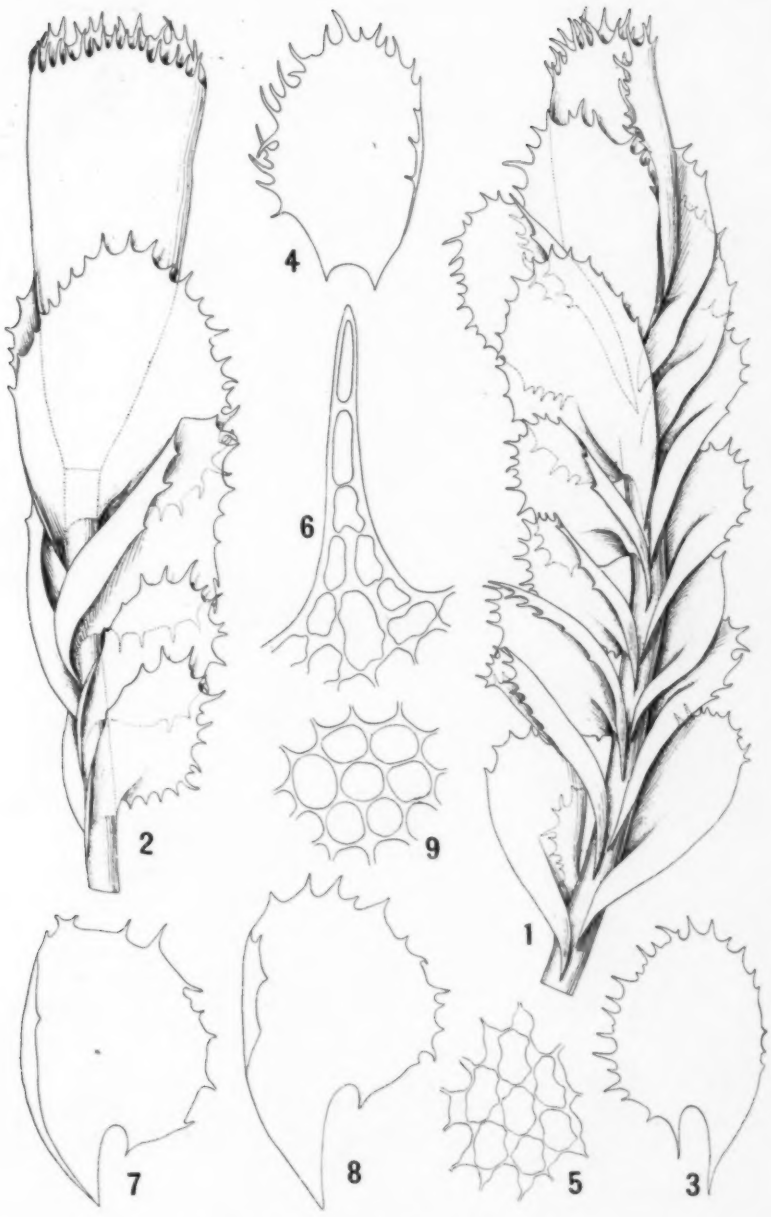
Vacciniaceae, 419
Vaccinium, 423; amoenum, 423; angustifolium, 420, 421, 422, 423, 424; angustifolium × corymbosum, 424; **atlanticum,** 422, 423; atrococcum, 425, 426; australe, 424; **Brittonii,** 420, 421, 422; caesariense, 424; caespitosum, 97, 467; canadense, 421; corymbosum, 420, 423, 424, 425, 426; corymbosum amoenum, 423; corymbosum glabrum, 424; disomorphum, 425; Dobbini, 422; fuscatum, 426; Myrtillus, 96; nigrum, 420; oreophilum, 96, 470, 472; pennsylvanicum, 420, 421; pennsylvanicum nigrum, 420, 421; scoparium, 470; vacillans, 420, 422; **vicinum,** 425; virgatum, 423
Vagnera amplexicaulis, 339; stellata, 415
Valeriana acutiloba, 470; edulis, 359; officinalis, 127; pauciflora, 29, 35; septentrionalis, 471
Valerianella macrocera, 339
Varronia **clarendonensis,** 16
Vaucheria, 167
Vauquelinia californica, 303
Veratrum album, 126; nigrum, 126; viride, 126; Woodii, 30
Verbascum Thapsus, 514, 515, 516, 517, 518, 519, 520, 521
Verbena bracteosa, 512; stricta, 354
Verbesina, 362
Veronica virginica, 358, 363; Wormskjoldi, 472
VESTAL, A. G. Black-soil prairie station in northeastern Illinois, A, 351
Viburnum dentatum, 29; molle, 29; nudum, 560; rufidulum, 214
Vicia americana, 339
Viola adunca, 339; biflora, 90; hirsutula, 29, 32, 35; papilionacea, 358; pedatifida, 356, 357; retroscabra, 339; rostrata, 29, 35; rotundifolia, 29, 32, 35; sp. 214
Vitis aestivalis, 560; rotundifolia, 214; vinifera, 367, 369; vulpina, 362, 363
Vittaria J. E. Smith, A revision of the genus, I. The species of the subgenus Radiovittaria, 391
Vittaria, 391, 392, 393, 394, 395, 399, 400, 404, 406; Bommeri, 401, 407;

elongata, 394; Forbsei, 394; Gardneriana, 398, 400, 401, 404, 407; gracilis, 400, 401; Karsteniana, 400, 401; **latifolia**, 398, 403, 404, 407; lineata, 394, 395, 397, 404; longipes, 405, 406; minima, 398, 399, 400; Moritziana, 405, 406; Orbignyana, 405, 406; remota, 398, 401, 402, 403, 404; Ruiziana, 398, 405; scolopendrina, 394, 395; sikkimensis, 395, 399; stipitata, 398, 404, 406; **Williamsii**, 398, 407

Waldsteinia, 331; Doniana, 331, 332; Fragarioides, 331, 332; idahoensis, 332; lobata, 332; parviflora, 332
Warea cuneifolia, 212
West Indian plants, Studies of,—V., 1
Widdringtonites Reichii, 298
Wild cotton plant (Thurberia thespesioides) in Arizona, The, 301
Williamsonia delawarensis, 297; marylandica, 297
Wisteria frutescens, 367, 368
Wrangelia, 173, 178

Xolisma ligustrina, 414
Xylaria, 170; tentaculata, 159
Xylorrhiza Brandegei, 101, 464; coloradensis, 101, 464
Xyris flexuosa, 561; sp. 561

Zodiomyces vorticellarius, 161
Zygalchemilla, 319, 321
Zygia, 8; arborescens, 8



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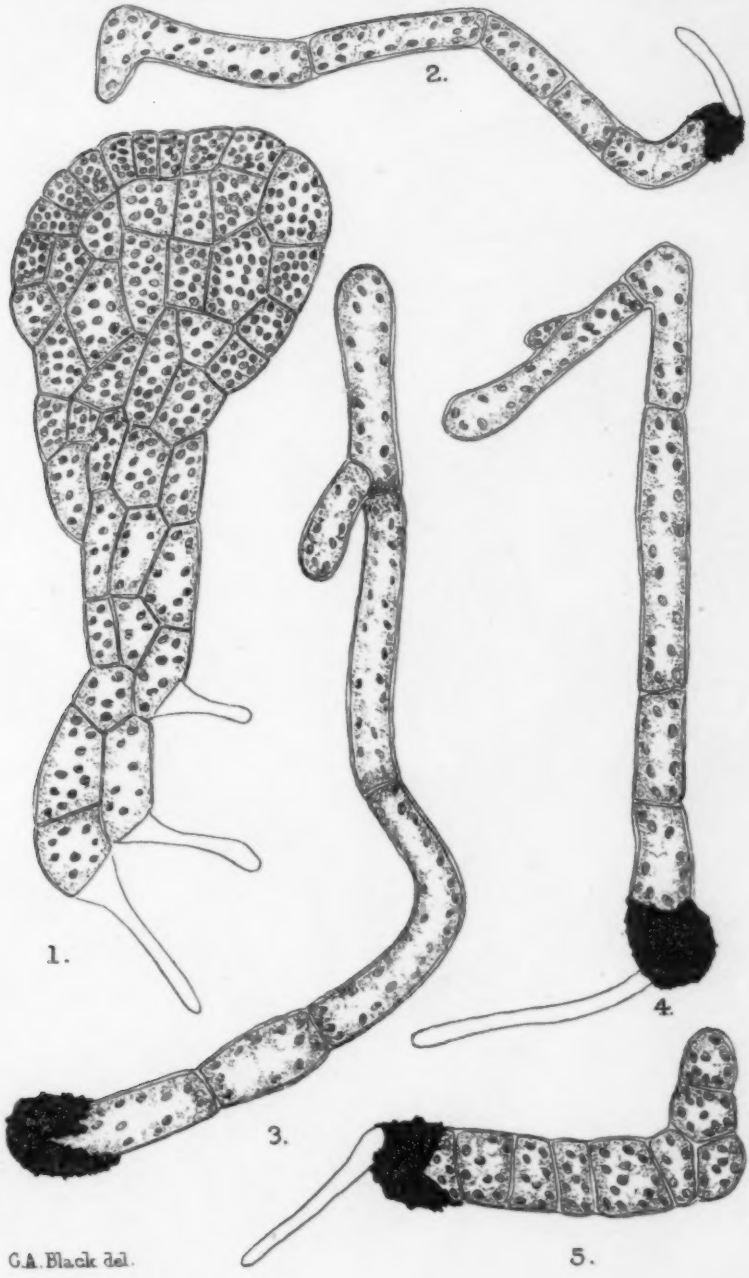

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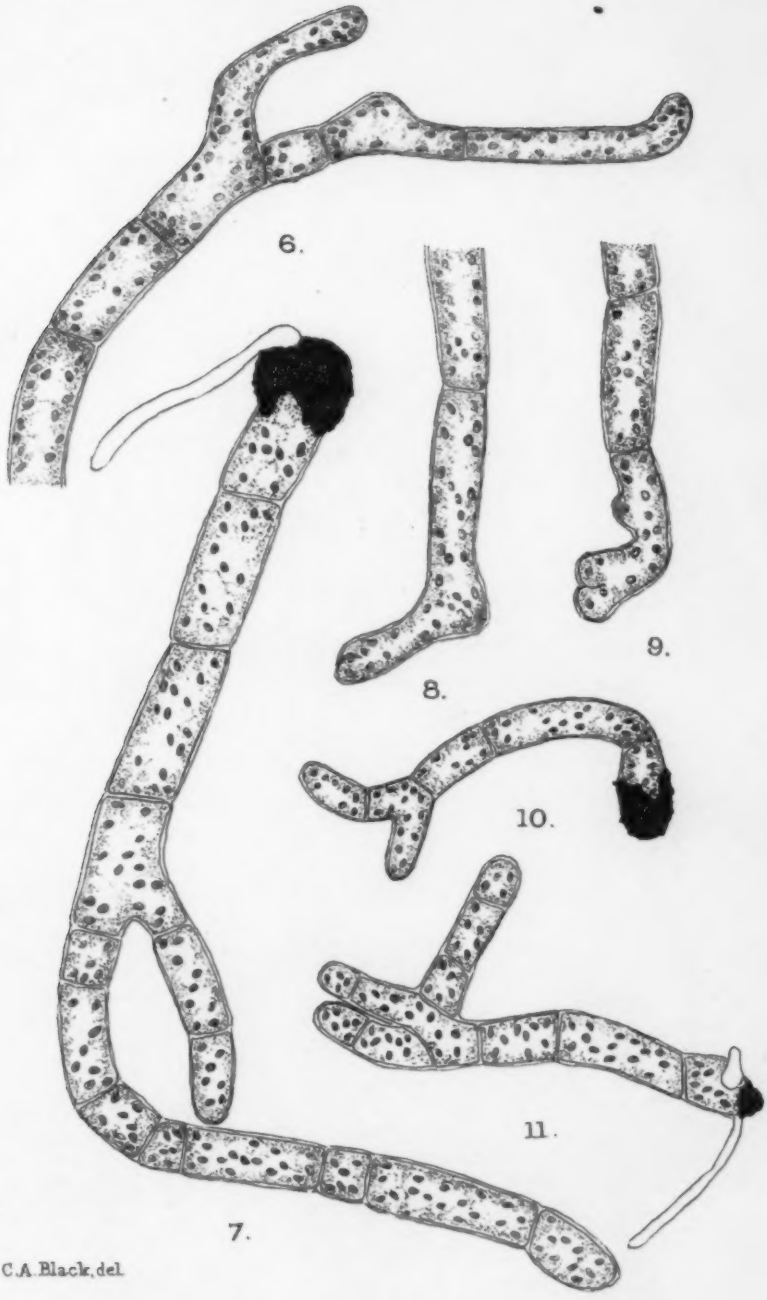

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CONTENTS

Report on the Hepaticae of Alaska. (Plate 21.) . ALEXANDER W. EVANS 577
Branched cells in the prothallium of Onoclea sensibilis L. (Plates 22 and 23.) CAROLINE A. BLACK 617
The correct name for the hemlock spruce . . . OLIVER A. FARWELL 621
INDEX TO AMERICAN BOTANICAL LITERATURE. 631

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